Original Article

EFFECTIVENESS OF NEUROMUSCULAR TRAINING FOR BASKET BALL PLAYERS ON PERFORMANCE OF STAR EXCURSION BALANCE TEST

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ABSTRACT

Background and introduction: To determine the effect of neuromuscular training program (NMTP) focused on core stability and lower extremity strength on performance of star excursion balance test (SEBT) in basketball players.

Method: : Pre to post test experimental study design randomised thirty Basketball players each 15 into NMTP and control group. Players trained together as a team in which NMTP group participated 4 weeks of NMTP twice a week and Control group followed their regular protocol as guided by their coach.

Results: When means of post intervention compared using Independent 't' between NMTP and Control group there is no statistically significant difference ($p<0.05$) in anterior, posterior-medial and posterior-Lateral direction reach distance of star Excursion test but there is a statistically significant difference in means of anterior, posterior-medial and posterior-Lateral direction reach distance when analyzed within in groups using Paired't' test and Wilcoxon signed rank test.

Conclusion: Neuromuscular Training program found to be effective for Basketball Players on Performance of Star Excursion Balance Test and this improvement can significantly predict the prevention of injury.

KEYWORDS: Neuromuscular Training Programme; Star Excursion Balance Test; Core Stability; Core Strengthening; Basketball Players.

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INTRODUCTION

In athletic activities due to running, sudden changing directions, falling etc, soft tissue injuries are very common in which ligament tears and joint sprains are predominate. These injuries involve 68.71% of lower extremities, 29.79% of knee problems, 2.75% spine, 1.99% of head injuries and 9% of other injury with fractures. The injuries of lower extremities consists primarily of ligament tears and fractures which are most commonly occurs at upper extremity.[1]

Basketball players are more prone to get soft tissue injuries due to their athletic activities. Most common injuries in basketball players are Ankle injuries [2] and Anterior cruciate ligament injury at knee.[3] Randall Dick et. al. state that in basketball players primary injury mechanisms are due to player contact, other contact (eg, contact with balls, standards, or the ground), and no contact in games and practices. Most game (52.3%) and practice (43.6%) injuries resulted from player contact. Few injuries were associated with contact with the standard or rim or with running into an out-of-bounds apparatus.[4] Oluwatoyosi Babatunde Alex Owoeye et. al. stated that Jumping or landing are the most common cause of injury among adolescent basketball players in Nigeria in which

most of the injuries were at the lower extremities with majority at the knee joint. Ligament sprain was the most common types of injury.[5] Meeuwisse WH et. al. found that the greatest number of injuries in Canadian intercollegiate basketball players occurring at the knee and at the ankle and stated that the risk factors for injury were previous injury, games as opposed to practice, player position, player contact, and court location.

Neuromuscular Training Program (NMTP) includes interventions that focus on increase control of center of mass. As the center of mass moves away from the base of support, there is an increased potential for biomechanical deviations to occur in the lower extremity. An improved ability to control this movement has the potential to decrease excessive forces on the lower extremity and ultimately decrease injury risk.

Neuromuscular training is a common therapeutic exercise component used by athletic trainers in the rehabilitation and prevention of injuries. In NMTP the exercises are focused on lower limb strength and core stability. Core stability is defined as dynamic trunk control which allows for the production, transfer, and control of force and motion to distal segments of the kinetic chain.[6] The goal of the NMTP is to improve the athlete's ability to control the center of mass during dynamic activity. Mandekbaum BR et. al. concluded that neuromuscular training program for 2 years, have benefits in decreasing the number of anterior cruciate ligament injuries in female soccer players.[3] Myer GD et. al. (2005) found that neuromuscular training program caused significant improvements in measures of atheletic performance with improvement in biomechanical measures related to anterior crucite ligament risk in female athletes[7] especially female basketball, soccer and volleyball players. Kibler WB et. al. stated that Core stability controls the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion to the terminal segment in integrated athletic activities.[6]

The star excursion balance test (SEBT) is a functional screening tool which assess the lower extremity dynamic stability, monitors rehabilitation progress, assess the injuries, and identifies the athletes who are at high risk for lower extremity injury.[2,8,9,10,11,12] To perform SEBT neuromuscular characteristics such as lower extremity coordination, balance, flexibility, and strength are required.[2,10,11] Plisky et al found that female athletes who had a composite reach distance on the SEBT of less than 94% of their limb length were 6.5 times more likely to have a lower extremity injury.[2] As a result, the SEBT may be a useful tool to assess the efficacy of training programs designed to reduce injury risk. Lauren C. Olmsted et al conducted a studied that SEBTs is effective measure for determining reach deficits in subjects with unilateral chronic ankle instability.[14] Another study by Plisky PJ et. al. found that Star Excursion Balance Test (SEBT) reach distance is associated with risk of lower extremity injury among high school basketball players.[2]

Despite the studies on NMPT, that has been found effective on improving SEBT performance on female soccer players. There are limited studies have done on basketball players emphasizing on performance of SEBT and there are no studies have found to find the SEBT performance after NMTP. Therefore, there is need to know the effect of NMPT on SEBT performance in Male basketball players which is predictable measure of lower limb injuries. The study had a research question does Neuromuscular Training Program improve the performance on Star Excursion Balance Test in male basketball players that can use to predict the prevention of injury. Hence, the purpose of this study to determine the effect of NMTP on SEBT performance for male basketball players with chronic ankle injury. The objectives of the study to evaluate the effect of Neuromuscular Training Program by analyzing the pre and post training measures of Star Excursion Balance Test in basketball players. To find the effect of Neuromuscular Training Program on performance of Star Excursion Balance Test comparing with regular training programs in basketball players. We hypothesized that there will be a significant effect on performance of Star Excursion Balance test following Neuromuscular Training Program in basketball players.

MATERIALS AND METHODS

Pre and post test experimental study design with 30 male basketball players volunteer were recruited from Sports Authority of India (SAI) Bangalore and study was conducted at K.T.G. Hospital from September 2012 to August 2013. Subjects included were Players who performed SEBT with an anterior right/left reach distance difference greater than 4cm, Players unable to complete SEBT, Players with history of Grade I and II ankle sprain unilateral ankle sprains, Presence of Ankle ligament laxity examined by Anterior Drawer Test on Ankle with the subject in a seated position and Age group between 20-30 years. Subjects excluded who were with history of Lower limb fractures, Ligament injury Grade III, Post surgical condition of lower limb, Acute and recurrent ankle sprain. Materials Used for intervention were Swiss ball, Measuring tapes, Marker, Barbells and Dumbles.

Procedure: Thirty subjects who fulfilled the inclusion criteria were informed about the study and a written consent was taken from the participants. Subjects were randomly allocated to either NMTP Group or control group. The patients were randomly allocated into two groups of thirty, 15 were in NMTP and 15 were in control group. Thirty pieces of paper used, with fifteen pieces having the word "NMTP Group" written on them, and fifteen having the words "Control Group" written on them. All the pieces of paper were tightly folded and placed in a box. After shaking the box thoroughly, each piece of paper was withdrawn individually and the group name was written on a list that corresponds with patient numbers from one to fifteen. The subjects in NMTP group participated 4 weeks of NMT program twice a week and other days they followed regular exercises recommended by their coach. The subjects in control group followed their regular protocol of training exercises as guided by their coach. Performance on Star excursion balance test (SEBT) was measured before and after 4 weeks of training program in both the groups.

Procedure of training for NMTP group: The NMTP group participated in 4 weeks of NMTP twice a week training sessions for a total of 8 sessions. The program at an Intensity of 80–85% of 1 RM, 8–12 repetitions and 3sets of exercise with rest period of 160 sec after each set were performed.[15] Each session consisted of 20-minutes pre training and post training warm-up exercises, two 45-minute increments of lower extremity strength and core stability training, and a 5-minute cool-down that included static and dynamic stretches for Calf, Quadriceps, Hamstring, Inner thigh and Hip flexors.

Pre training and Post training warm-up exercises[16]: 1.Running exercises, 8 minutes (opening warm up): Running straight ahead, Running hip out, Running hip in, Running circling, Running and jumping. 2. Strength, Plyometrics, Balance, and 10 minutes: the plank, side plank, single leg balance, squats, jumping. 3. Running exercises, 2 minutes (final warm up): running over pitch, bounding run, running and cutting.

Neuromuscular Training Program: NMTP included core stability exercise and lower limb strengthening programme. The core stability component was divided into 5 phases of progressive exercises. **Phase 1:** Lateral jump and hold, Step-hold, Single-tuck jump soft landing, Front lunges, Lunge jumps, Swiss ball back hyperextension. **Phase 2:** Lateral jumps, Jump single-leg hold, Double-tuck jump, Walking lunges, Scissor jumps, Swiss ball back hyperextension. **Phase 3:** Lateral hop and hold, Hop-hold, Repeated-tuck jump, Walking lunges unilaterally weighted, Lunge jumps unilaterally weighted, Swiss ball hyperextensions with back fly. **Phase 4:** Lateral hops, Hop-hop-hold, Side-to-side barrier tuck jumps, Walking lunges with plate crossover, Scissor jumps unilaterally weighted, Swiss ball hyperextensions with ball reach lateral. **Phase 5:** X-hops, Crossover-hop-hop-hold, Side-to-side reaction barrier tuck jumps, walking lunges with unilateral shoulder press, Scissor jumps with ball swivel, Swiss ball hyperextensions with lateral ball catch.

Lower Extremity Strength Training: Component of the Neuromuscular Training Program included Strength Training, First day of the week with Dumbbell hang snatch, Barbell squat, Barbell bench press, Assisted Russian hamstring curl, Dumbell shoulder press, Hamstring curls, Latissimus pull-down, Lateral lunges. Second day of the week- Barbell hang cleans, Sumo squat dumbell pick-up, Dumbell incline press, Gluteal/hamstring raise, Dumbell back fly, Band

ankle inversion/eversion, Walking lunges, Dumbell Ys and Ts Dumbell lateral raise.

Regular Exercises: The exercises recommended by their coach included were knee and hip flexibility exercises, ankle dorsiflexion ROM exercises stretching exercises and Plyometrics.[17,18] Warm – up exercises:Jog line to line, Shuttle run, Backward running. Stretching exercises: Calf stretch, Quadriceps stretch, Figure four hamstring stretch, Inner thigh stretch, Hip flexor stretch. Strengthening exercises: Walking lunges, Single toe raises. Plyometrics: Lateral hops over cone, Forward/Backward hops over cone, Single leg hops over cone, Scissor jump. Agilities: Shuttle run with forward/backward running, Diagonal runs, Bounding run.

Outcome measurement: The reliability of the SEBT has previously been established for specific measurement methods. SEBT was performed (Figure: 1) by drawing three lines in which anterior line faces the mid line and two posterior lines, which had 45^0 to anterior base. The posterior lines were in posteromedial and posterolateral direction. The participant was asked to reach as far as possible along each of three lines by making light touch and reach back to centre while maintaining a single leg stance with the other leg in centre of grid. The SEBT composite score was calculated by dividing the sum of the maximum reach distance in the anterior (AT), posteromedial (PM), and posterolateral (PL) directions by 3 times the limb length (LL) of the individual, then multiplied by 100 $\{[(AT + PM + PL)/(LL \times 3)] \times 100\}$. The terminology of excursion directions is based on the direction of reach in relation to the stance leg. When reaching in the anterior, posteromedial and posterolateral directions, participants must reach behind the stance leg to complete the task. Each subject received verbal instruction and visual demonstration of the SEBT from the examiner. The subjects stood on 1 lower extremity, with the most distal aspect of their great toe on the center of the grid. The subjects were then asked to reach in the anterior, posteromedial, and posterolateral direction, while maintaining their single-limb stance. Six practice trials were performed on each limb for each of the 3 reach directions prior to official testing.

On the seventh trial, the examiner visually recorded the most distal location of the reach foot as it contacted the grid in the 3 directions. The trial was discarded and the subject repeated the testing trial if the subject was unable to maintain single-limb stance, the heel of the stance foot did not remain in contact with the floor, weight was shifted onto the reach foot in any of the 3 directions, or the reach foot did not return to the starting position prior to reaching in another direction. The process was then repeated while standing on the other lower extremity. The order of limb testing was counterbalance randomized by the tester. The subject's limb length measurements, from the most distal end of the anterior superior iliac spine to the most distal end of the lateral malleolus on each limb, were taken and recorded.

Figure 1: Subject performing the star excursion balance test on the left lower extremity in posterolateral direction.

Figure 2: Subject performing Latissimus pull-down.

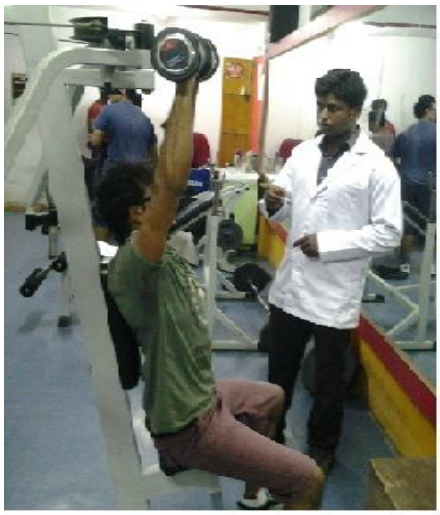

Figure 3: Subject performing Dumbell houlder press.

Figure 5: subject performing Dumbell incline press.

Figure 7: Subject performing Hamstring curls.

Figure 4: Subject performing Dumbell back fly.

Figure 6: subject performing Barbell sqat.

Statistical Methods:

Descriptive statistical analysis has been carried out in this study and presented as mean ± SD. Significance is assessed at 5 % level of significance with p value 0.05 less than this is considered as statistically significant difference. Pearson Chi-Square test and has been used to analyze the significant of basic characteristic of gender, age and affected side distribution of the subjects studied. Paired 't' test as a parametric and Wilcoxon signed rank test as a non-parametric test have been used to analysis the variables pre-intervention to post-intervention with calculation of percentage of change. Independent 't' test as a parametric and Mann Whitney U test as a non-parametric test have been used to compare the means of variables between groups with calculation of percentage of difference between the means. The Statistical software namely SPSS 16.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS AND TABLES

The study was carried on total of 30 male basketball players. In NMTP group there were 15 subjects with mean age 25.73 years and in Control Group there were 15 subjects with mean age 25.47 years (Table 1).

Basic Characteristics of		NMTP group	Control group	Between the groups
Number of subjects studied (n)		15	15	--
Age in years (Mean± SD)		25.73± 3.08 (20-30)	25.47± 3.06 (20-30)	p=0.387 (NS)
Gender	Males	15	15	--
Affected limb	Right	9	6	p=0.000
	Left	6	9	p=0.000
Total number of subjects		15	15	30

a- Pearson Chi-Square

Table 1: Basic Characteristics of the subjects studied.

	Pre intervention (Mean±SD in %) min-max	Post intervention (Mean±SD in %) min-max	Perecntage of change	t value[a] (Parametric)	Z value[b] (Non parametric significance)	95%Confidence interval of the difference Lower	Upper	Effect Size r value	Parametric P value
	NMTP Group								
Anterior direction	63.88±9.46 (32.19-72.00)	72.09±3.95 (63.09-78.04)	12.85%	-3.552	-3.408 P =0.001**	-13.16	-3.25	0.49 (Medium)	P =0.003**
Posterior-medial direction	47.37±4.94 (38.09 -56.32)	56.97±6.04 (46.42-65.82)	20.26%	-11.985	-3.408 P =0.001**	-11.31	-7.88	0.65 (Large)	P =0.000**
Posterior-Lateral direction	54.21±7.79 (43.67- 67.53)	61.36±8.53 (50.00-76.62)	13.18%	-5.657	-3.408 P =0.001**	-9.85	-4.43	0.4 (Medium)	P =0.000**
	CONTROL GROUP								
Anterior direction	67.00±12.02 (41.30- 87.64)	74.14±11.51 (49.00-92.13)	10.65%	-20.134	-3.408 P =0.001**	-7.9	-6.38	0.29 (Small)	P=0.000**
Posterior-medial direction	52.86±8.18 (43.47-72.41)	60.72±8.21 (49.31-79.31)	14.86%	-15.79	-3.408 P =0.001**	-8.93	-6.79	0.43 (Medium)	P =0.000**
Posterior-Lateral direction	51.67±6.89 (42.69-64.63)	61.38±5.86 (52.17-72.00)	18.79%	-17.641	-3.408 P =0.001**	-10.89	-8.53	0.6 (Large)	P =0.000**

** Statistically Significant difference p<0.05 a. Pared t test. b. Wilcoxon Signed Ranks Test ; NS- Not significant

Table 2: Analysis of normative percentage of reach distances of Star Excursion Balance Test Performance within NMTP and Control Group.

	NMTP Group (Mean±SD) in percentage min-max	CONTROL GROUP (Mean±SD) in percentage min-max	Perecntage of difference	t value[a] (Parametric)	Z value[b] (Non parametric)	95%Confidence interval of the difference Lower	Upper	Effect Size r value	Parametric Significance P value[a]
	PRE INTERVENTION COMPARSION								
Anterior direction	63.88± 9.46 (32.19-72.00)	67.00± 12.02 (41.30- 87.64)	-4.76%	-0.789	-0.996 P=0.319 (NS)	-11.21	4.97	0.14 (Small)	P =0.437 (NS)
Posterior-medial direction	47.37± 4.94 (38.09 -56.32)	52.86± 8.18 (43.47-72.41)	-10.95%	-2.225	-1.95 P=0.051*	-10.55	-0 .43	0.37 (Medium)	P=0 .034
Posterior-Lateral direction	54.21± 7.79 (43.67- 67.53)	51.67± 6.89 (42.69-64.63)	4.79%	0.945	-0.893 P=0.372 (NS)	-2.96	8.04	0.17 (Small)	P =0.353 (NS)
	POST INTERVENTION COMPARSION								
Anterior direction	72.09± 3.95 (63.09-78.04)	74.14± 11.51 (49.00-92.13)	-2.80%	-0.653	-1.037 P=0.309**	-8.49	4.38	0.11 (Small)	P=0.519 (NS)
Posterior-medial direction	56.97± 6.04 (46.42-65.82)	60.72± 8.21 (49.31-79.31)	-6.37%	-1.427	-1.017 P=0.086 (NS)	-9.15	1.63	0.25 (Small)	P= 0.165 (NS)
Posterior-Lateral direction	61.36± 8.53 (50.00-76.62)	61.38± 5.86 (52.17-72.00)	-0.03%	-0.008	-0.228 P=0.820 (NS)	-5.5	5.45	0.009 (Small)	P =0.993 (NS)

** Statistically Significant difference p<0.05; NS- Not significant; a. Independent t test. b. Mann Whitney U test Test

Table 3: Comparison of normative percentage of reach distances Star Excursion Balance Test Performance between the NMTP Group and Control Group.

There is no significant difference in mean ages between the groups. Analysis of normative percentage of reach distances of Star Excursion Balance Test Performance within NMTP and Control Group (Table 2) found that there is a statistically significant (p<0.05) improvement in means of anterior, posterior-medial and posterior-Lateral direction reach distance of star Excursion test. Comparison of Star Excursion Balance Test Performance between Groups (Table 3) found that there is no statistically significant difference in pre-intervention means of anterior and posterior-lateral direction where as there is a significant difference in Posterior-medial direction reach distance. When post intervention means were compared there is no statistically significant difference in means of anterior, posterior-medial and posterior-Lateral direction reach distance of star Excursion test.

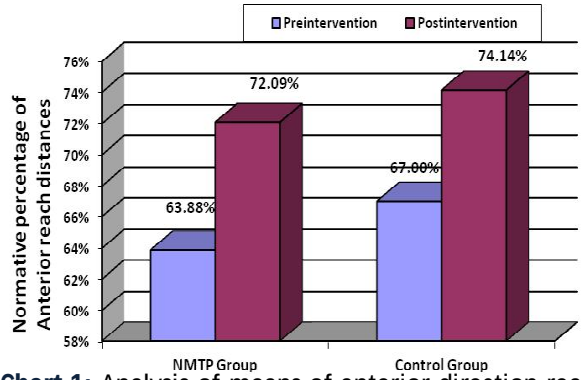

Chart 1: Analysis of means of anterior direction reach distance within the NMTP Group and Control Group (Pre to post analysis)

The above graph shows that there is a statistically significant difference in means of normative percentage of anterior reach distance in NMTP Group and in Control Group when analyzed within in groups from pre intervention to post intervention.

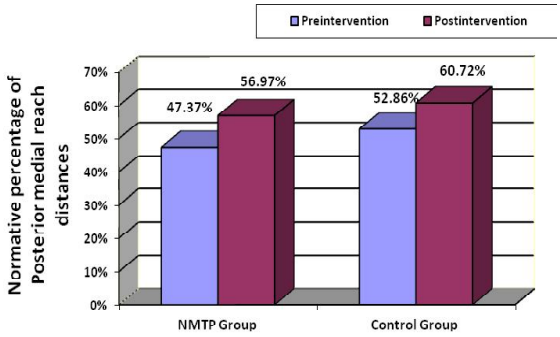

Chart 2: Analysis of Posterior Medial direction reach distance within the NMTP Group and Control Group (Pre to post analysis)

The above graph shows that there is a statistically significant difference in means of normative percentage of posterior Medial direction reach distance in NMTP Group and in Control Group when analyzed within in groups from pre intervention to post intervention.

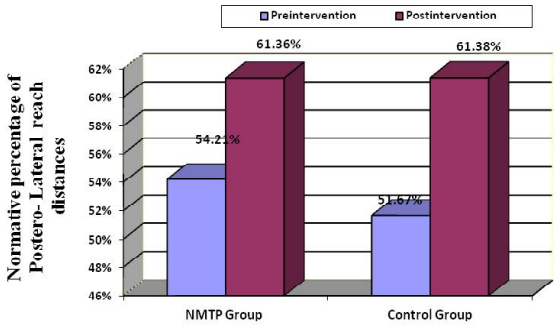

Chart 3: Analysis of means of Postero-Lateral Direction reach distance within the NMTP Group and Control Group (Pre to post analysis).

The above graph shows that there is a statistically significant difference in means of normative percentage of posteriolateral reach distance in NMTP Group and in Control Group when analyzed within in groups from pre intervention to post intervention.

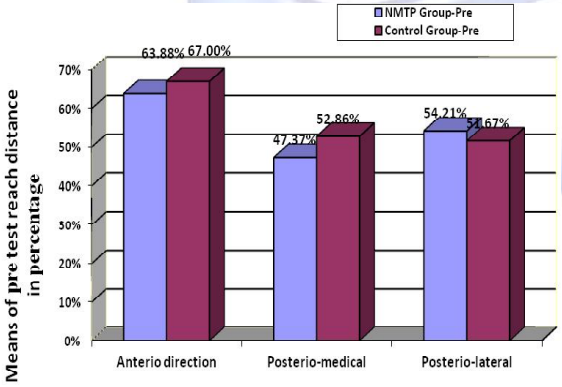

Chart 4: Comparison of pre intervention means between NMTP Group and Control Group.

The above graph shows that there is no statistically significant difference in means of anterior and posterior-lateral direction between NMTP Group and Control Group, where as there is a significant difference between the groups in Posterior-medical direction reach distance.

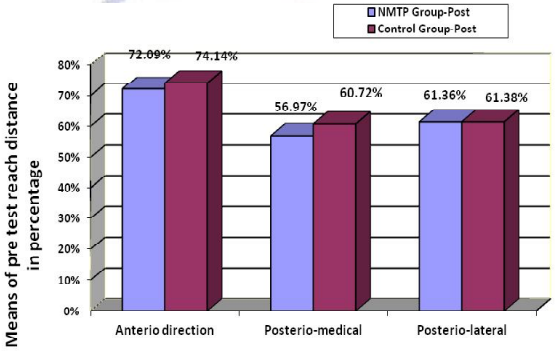

Chart 5: Comparison of means of post intervention between NMTP Group and Control Group.

The above graph shows that when means of post intervention compared there is a no statistically significant difference in means of anterior, posterior-medial and posterior-Lateral direction reach distance of star Excursion test.

DISCUSSION

Analysis from the results found that the Neuromuscular training program group significantly shown greater percentage of improvement on performance of star excursion balance test than control group who received only regular exercises when analysed before to after intervention, however there is no statistically significant difference in improvement when post intervention means were compared between the groups.

In Control Group the improvement in SEBT scores could be because the subjects even though were not in NMTP training program, they were been recommended for regular exercises advised by their coach which might have influence the strengthening of core muscle and lower limbs, and improved knee, hip flexibility and improved ankle dorsiflexion ROM. The coach advised regular basketball training program which included training sessions as warming up (up to 20 min.), exercises for the improvement of individual technical actions (up to 40 min., ball dribble for 10 min., shooting for 20 min. and passing for 10 min.); tactical training (up to 30 min.).[19] Robinson and Gribble suggested that improvement in the SEBT are not due to strength or core stability, it may due to good knee and hip flexibility of the stance limb.[20]

Curtis R. Basnett et al (2013) studied that ankle dorsiflexion ROM can improve the performance on SEBT.[21] in the present study the exercises included knee and hip flexibility exercises, ankle dorsiflexion ROM exercises stretching exercises and Plyometrics.[17,18] Warm – up exercises: Jog line to line, Shuttle run, Backward running. Stretching exercises: Calf stretch, Quadriceps stretch, Figure four hamstring stretch, Inner thigh stretch, Hip flexor stretch. Strengthening exercises: Walking lunges, Single toe raises. Plyometrics: Lateral hops over cone, Forward/ Backward hops over cone, Single leg hops over cone, Scissor jump. Agilities: Shuttle run with forward/backward running, Diagonal runs, Bounding run. These combination of regular exercises may influenced improvement in performance in SEBT.

In NMTP group, among three directions there is significant improvements in the postero-lateral and poster-medial direction of SEBT this could be due to effect of Neuromuscular training program and regular exercises performed by the athletes. Regular exercise program is a common therapeutic exercise component used by athletic trainers in the rehabilitation and prevention of injuries. In NMTP the exercises are focused on lower limb strength and core stability. Core stability is dynamic trunk control which allows for the production, transfer, and control of force and motion to distal segments of the kinetic chain.[6] Poor core stability and decreased muscular synergy of the trunk and hip stabilizers leads to decrease performance in power activities and increases the incidence of injury due to lack of control of the centre of mass.[8,22] The NMTP improves the athlete's ability to control the centre of mass during dynamic activity. The results of this study are supported by previous studies. Neuromuscular training program that focused on lower extremity strength and core stability significantly improved the composite SEBT scores in female soccer players.[8] Myer GD et. al. studied the effect of neuromuscular training program on measures of athletic performance and lower-extremity movement biomechanics in female athletes specially female basketball, soccer and volleyball players and they found significant improvements in measures of atheletic performance.[7]

Decreased neuromuscular control of the trunk appears to influence dynamic stability of the lower extremity during high-speed athletic maneuvers.[13] NMTP Improves the fitness levels and enhance resistance to injury. It helps to maintain balance and improve the ability to control center of mass during dynamic activity. It helps in improving body flexibility and strength. Following NMTP program the group shown no significant improvement in anterior direction. This is supported by the previous study done by Alyson Filipa et.al., in their study no differences in reach were found in the anterior direction.[8]

Performance on Star excursion balance test compared between both groups found no statistical difference in post means. However there is clinical significant greater improvement in NMTP group than control group, from pre to post intervention percentage of changes in improvement in NMTP Group is -12.85% in anterior direction, -20.26% Posterior-medial direction, -13.18% Posterior-Lateral direction and changes in control Group is -10.65% - Anterior direction, -14.86% Posterior-medial direction, -18.79% Posterior-Lateral direction shows that greater percentage of change is found in NMTP group. This could be due to 8-weeks Neuromuscular training program that focused on lower extremity strength and core stability found added effect along with regular exercises that significantly improved composite SEBT scores than the control group who relieved only regular exercises. Following the training program, there was no statistical significant difference in post means of composite score between the groups. This may be due to the design of the NMTP and regular exercises which focused on the performance of exercises equally on each limb and likely contributed to the difference in limb effect. Establishing limb symmetry was important because limb dominance and side-to-side imbalance in lower extremity measures have been found to be a risk factor for ligament injury.[23,24] Plisky PJ et al studied that the individuals who participated in the NMTP showed improvements in the SEBT composite scores when compared to non-trained controls. However, its effect on knee or ankle injury rate was not assessed in their study.

In the present study NMTP program was implemented twice a week for 4 weeks therefore the duration of the study carried might have not shown significant difference in between the groups. Only 15 subjects were studied in each group showing small to medium effect that signifies that the small sample size which can affect the results. The SEBT is reliable and predictive measure of lower extrimity injury in basketball players.[2] However in the study the measurement was standardised by considering the composite scores of SEBT as measured by the previous studies.

However there is no statistically significance difference in improvement of SEBT score obtained between the groups, based on the finding in this study found that there is a significant effect of Neuromuscular training program along with regular exercise on performance of Star Excursion Balance Test for male Basket ball players with chronic ankle sprain. Hence the present study rejects null hypothesis.

The study has certain limitation small sample size which decreases the applicability to other populations, training was performed without the benefits of random assignment and without the blinding of the investigators, only short term effect are found and male basket players with chronic ankle sprain were studied. Further long term studies are needed to find effect of NMTP on other athletics with different sports on larger sample size.

CONCLUSION

Neuromuscular Training program found to be effective for Male Basketball Players with chronic ankle sprain on Performance of Star Excursion Balance Test and this improvement can significantly predict the prevention of injury. Therefore implementation of neuromuscular training program for athletes with chronic ankle sprain is recommended to prevent from injuries.

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Conflicts of Interest: None

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