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Comparison of Sports Specific Balance Training Programs in Improving Balance and Agility in Basketball Players

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Abstract: *The basketball players can go anywhere freely in the court where it divides into upper zone and lower zone and therefore they may need to change in direction together with dribbling, jump shot and passing on even or hard surface. All of the skills above require the players to have great joint acceleration from jump landing and cutting maneuvers. Comparative study was conducted on 60 subjects according to inclusion and exclusion criteria between the Group A and group B included 30 subjects each.Group A received sports specific balance training program while balance training programme only was given to Group B for 4 weeks.Star excursion balance test and mini zig zag drill test were used as outcome measure.Both the group showed the significant improvment within the group analysis as p value <0.0001.But sports specific balance training program is more effective than balance training program in improving balance and agility in basketball players as p value is <0.0001 between the group comparison.*

Key words: *Basketball players,balance, sport specific programme*

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I. Introduction

Basketball is a contact sport in which the players need to involve physical fitness, precision motor skills, team tactics and individual and group motivation. The basketball players can go anywhere freely in the court where it divides into upper zone and lower zone and therefore they may need to change in direction together with dribbling, jump shot and passing on even or hard surface. All of the skills above require the players to have great joint acceleration from jump landing and cutting maneuvers. Therefore, many of the basketball players were trained to run, jump and landing more compared with the athletes of the other sports and lastly may lead to injuries to lower extremities such as ankle sprain and overuse knee injuries.[(1)]

Athletic training often prescribe exercises in an attempt to enhance an athlete's postural control or balance perhaps reduce risk of injury. The goal of balance training is to improve balance through perturbation of the musculoskeletal system that will facilitate neuromuscular capability ,readiness and reaction.[(2)] A progressive balance training program had been designed to challenge a subject's ability to maintain a single limb stance while performing various balance activities such as predictable and unpredictable changes in direction, landing from a hop and dynamic reaching tasks was used for dynamic balance training[(3)].

The purpose of study is to improve balance ability in basketball players, thus, reducing the risk of musculoskeletal injuries.

The instrument used to assess balance was star excursion balance test(sebt) and mini zig zag drill test[(4)]. Sports specific balance training program included specific exercises related to the basketball in which the main aim was to improve single leg stance balance by performing activities such as swinging the raised leg ,single leg squat, performing functional activities such as dribbling ,catching or throwing the ball in single leg stance. With improving single leg stance balance jumping and landing techniques were also asked to perform such as jumping and landing on single leg and on both.

Balance training program included the same exercises as in sports specific balance training program with exercises to be performed on the balance board such as double leg stance on balance board, single leg squat while rotating the balance board and single limb hops in 4 directions.Current study aims to compare the effects of sports specific balance training program and balance training program in improving balance and agility in basketball players.

II. Materials And Methodology

This comparative study was carried out on normal healthy school going basketball players of Nashik.Total 60 players both male and female of aged 14 to 24 years were included in this study.
TYPE OF STUDY -Comparative study

SAMPLING METHODS -Convinent sampling

SAMPLE SIZE -Group A-30 (sport specific balance training program)
-Group B-30 (balance training program)
-Total 30+30=60

STUDY SETTING -Vishwas lawns,Ashoka universal school,Yashwant vyayam shala

DURATION OF STUDY - Six months

INCLUSION CRITERIA -Normal healthy individuals
-Both male and female professional basketball players
-Age group 14 to 25 years of age

EXLUSION CRITERIA -Players who sustained upper and lower extremity injuries for the past 6 months
-History of major surgery on upper and lower extremity
-History of neurological conditions that can affect balance
-Recent fractures of upper and lower extremity

MATERIALS USED-Pen ,paper ,consent form ,cones ,wobble board ,measuring tape

Procedure Methodology

Subjects were selected considering the inclusion and exclusion criteria and were randomly distributed in 2 groups As GROUP A- Specific balance training program and GROUP B - Balance training program
Procedure was explained to them and a written consent was obtained. Written informed consent was distributed in all the subjects in order to make sure they understood the procedure of research. Before starting the sports specific balance training program (pre intervention) and after training program (post intervention),all the subjects were involved in assessment of balance.
The balance assessment involved static and dynamic balance. The instrument used to assess balance was STAR EXCURSION BALANCE TEST(SEBT) and MINI ZIG ZAG DRILL TEST.
Star excursion balance test (SEBT) is a series of single-limb squats using the non stance limb to reach maximally to touch a point along 1 of 8 designated lines on the ground[(5)]. The goal of the task is to have the individual establish a stable base of support on the stance limb in the middle of the testing grid and maintain it through a maximal reach excursion in one of the prescribed directions[(5)].
Mini zig zag drill test.This test was created to test the speed and agility of basketball players. The player starts from the back line runs in diagonal through the first cone and passes it, runs at the center of the court and passes the second cone and then runs until the last cone situated in the corner of the gym.[(6)]

Stastical analysis

Primer version 7 was used for data analysis in this study.To compare pre and post treatment values paired t test was done within the groups whereas to compare the difference between two groups unpaired t test was done.

III. Result

TABLE NUMBER 01 :Comparison of pre and post mean treatment score of star excursion balance test of left leg stance in group A

	PRE (MEAN)	POST (MEAN)	PRE(SD)	POST(SD)	p-VALUE	t-VALUE	RESULT
ANTERIOR	65.22	66.85	1.555	1.49	<0.0001	-8.712	EXTREMELY SIGNIFICANT
ANTEROLATERAL	79.5	80.77	1.483	1.355	<0.0001	-10.125	EXTREMELY SIGNIFICANT
LATERAL	72.18	73.54	2.331	2.333	<0.0001	-8.976	EXTREMELY SIGNIFICANT
POSTEROLATERAL	82.32	83.67	3.195	3.324	<0.0001	-7.947	EXTREMELY SIGNIFICANT
POSTERIOR	69.62	71.29	2.092	2.006	<0.0001	-10.185	EXTREMELY SIGNIFICANT

POSTEROMEDIAL	77.91	79.62	3.219	3.222	<0.0001	11.378	EXTREMELY SIGNIFICANT
MEDIAL	64.53	66.05	1.621	1.549	<0.0001	12.533	EXTREMELY SIGNIFICANT
ANTEROMEDIAL	72.68	73.83	1.585	1.614	<0.0001	9.963	EXTREMELY SIGNIFICANT

TABLE NUMBER 02: Comparison of pre and post mean treatment score of star excursion balance test of right leg stance in group A

	PRE (MEAN)	POST (MEAN)	PRE (SD)	POST (SD)	p-VALUE	t-VALUE	RESULT
ANTERIOR	65.35	66.94	1.807	1.807	<0.000	-12.268	EXTREMELY SIGNIFICANT
ANTEROLATERAL	79.4	80.98	1.796	1.657	<0.000	-9.688	EXTREMELY SIGNIFICANT
LATERAL	72.03	73.78	2.308	2.533	<0.000	-4.81	EXTREMELY SIGNIFICANT
POSTEROLATERAL	81.72	83.13	3.34	3.146	<0.000	-8.887	EXTREMELY SIGNIFICANT
POSTERIOR	69.55	70.82	2.13	2.111	<0.000	-8.045	EXTREMELY SIGNIFICANT
POSTEROMEDIAL	77.26	78.97	3.554	3.576	<0.000	-9.874	EXTREMELY SIGNIFICANT
MEDIAL	64.46	65.68	1.831	1.707	<0.000	-12.679	EXTREMELY SIGNIFICANT
ANTEROMEDIAL	72.3	73.59	1.838	1.563	<0.000	-8.857	EXTREMELY SIGNIFICANT

TABLE NUMBER 03: Comparison of pre and post mean treatment score of star excursion balance test of left leg stance in group B

	PRE (MEAN)	POST (MEAN)	PRE (SD)	POST (SD)	p-VALUE	t-VALUE	RESULT
ANTERIOR	64.97	67.78	4.075	4.201	<0.000	-14.524	EXTREMELY SIGNIFICANT
ANTEROLATERAL	79.02	81.21	1.889	2.021	<0.000	-13.03	EXTREMELY SIGNIFICANT
LATERAL	72.37	74.69	1.858	2.267	<0.000	-13.42	EXTREMELY SIGNIFICANT
POSTEROLATERAL	83.72	85.8	1.612	1.729	<0.000	-14.856	EXTREMELY SIGNIFICANT
POSTERIOR	9.2	71.34	1.928	2.178	<0.000	-13.386	EXTREMELY SIGNIFICANT
POSTEROMEDIAL	78.56	81.2	1.915	2.13	<0.000	-13.792	EXTREMELY SIGNIFICANT
MEDIAL	64.45	66.9	1.601	1.74	<0.000	-15.96	EXTREMELY SIGNIFICANT
ANTEROMEDIAL	73.01	75.11	1.646	1.67	<0.000	-14.769	EXTREMELY SIGNIFICANT

TABLE NUMBER 04: Comparison of pre and post mean treatment score of star excursion balance test of right leg stance in group B

	PRE (MEAN)	POST (MEAN)	PRE (SD)	POST (SD)	p-VALUE	t-VALUE	RESULT
ANTERIOR	65.49	68.01	1.793	1.983	<0.000	-13.163	EXTREMELY SIGNIFICANT
ANTEROLATERAL	79.61	81.57	1.877	1.912	<0.000	-11.378	EXTREMELY SIGNIFICANT
LATERAL	73.32	75.7	1.589	1.842	<0.000	-12.749	EXTREMELY SIGNIFICANT
POSTEROLATERAL	83.56	85.85	1.743	1.705	<0.000	-16.571	EXTREMELY SIGNIFICANT
POSTERIOR	69.68	71.65	1.473	1.568	<0.000	-13.193	EXTREMELY SIGNIFICANT
POSTEROMEDIAL	78.57	80.79	2.068	1.889	<0.000	-16.012	EXTREMELY SIGNIFICANT
MEDIAL	64.78	66.97	1.728	1.642	<0.000	-10.419	EXTREMELY SIGNIFICANT
ANTEROMEDIAL	72.67	75.17	1.723	1.748	<0.000	-14.855	EXTREMELY SIGNIFICANT

TABLE NUMBER 05: Comparison of pre and post mean treatment score of Mini zig zag drill test in group A and B

	GROUP A	GROUP B
PRE (MEAN)	23.93	24.95
POST (MEAN)	22.32	22.39
PRE (SD)	2.2	1.669
POST (SD)	2.19	2.06
p-VALUE	<0.000	<0.000
t-VALUE	10.462	12.083
RESULT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT

TABLE NUMBER 06: UNPAIRED t test

Comparison of post mean difference score of star excursion balance testof left leg stance between group A and group

		ANTERIOR	ANTEROLATERAL	LATERAL	POSTEROLATERAL
GROUP A	MEAN DIFFERENCE	1.598	1.267	1.353	1.346
	SD	0.9956	0.6854	8256	0.9275
GROUP B	MEAN DIFFERENCE	2.81	2.189	2.33	2.078
	SD	1.06	0.9202	0.9508	0.7661
	P-VALUE	0	0	0	0.001
	T-VALUE	-4.563	-4.401	-4.248	-3.334
	RESULT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT
		POSTERIOR	POSTEROMEDIAL	MEDIAL	ANTEROMEDIAL
GROUP A	MEAN DIFFERENCE	1.657	1.712	1.51	1.156
	SD	0.9032	0.824	0.6705	0.6283
GROUP B	MEAN DIFFERENCE	2.134	2.643	2.453	2.1
	SD	0.8733	1.05	0.8419	0.7789
	P-VALUE	0.042	0	0	0
	T-VALUE	-2.082	-3.84	-4.801	-5.168
	RESULT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT

TABLE NUMBER 07: UNPAIRED t test

Comparison of post mean difference score of star excursion balance test of right leg stance between group A and group B

		ANTERIOR	ANTEROLATERAL	LATERAL	POSTEROLATERAL
GROUP A	MEAN	1.587	1.577	1.853	1.411
	SD	0.7087	0.8918	1.951	0.8694
GROUP B	MEAN	2.521	1.955	2.387	2.288
	SD	1.049	0.9409	1.025	0.7561
	P-VALUE	0	0.116	0.19	0
	T-VALUE	-4.04	.1.594	-1.325	-4.169
	RESULT	EXTREMELY SIGNIFICANT	NOT SIGNIFICANT	NOT SIGNIFICANT	EXTREMELY SIGNIFICANT
		POSTERIOR	POSTEROMEDIAL	MEDIAL	ANTEROMEDIAL
GROUP A	MEAN	1.279	1.711	1.199	1.395
	SD	0.8708	0.9491	0.5223	0.656
GROUP B	MEAN	1.967	2.223	2.188	2.507
	SD	0.8169	0.7603	1.15	0.9245
	P-VALUE	0.003	0.025	0	0
	T-VALUE	-3.159	-2.305	-4.286	-5.375
	RESULT	EXTREMELY SIGNIFICANT	NOT SIGNIFICANT	EXTREMELY SIGNIFICANT	EXTREMELY SIGNIFICANT

TABLE NUMBER 08: UNPAIRED t test

Comparison of post mean difference score of mini zig zag drill test between group A and B

GROUP A	GROUP B
MEAN	MEAN
-1.612	-2.555
GROUP A	
MEAN	-1.612
SD	0.8439
GROUP B	
MEAN	-2.555
SD	1.158
P VALUE	0
t VALUE	3.605
RESULT	EXTREMELY SIGNIFICANT

IV. Discussion

The ability of static balance among the group A can be increased due to the neural adaptation to the specific task. **Kean** and colleagues found that balance training is able to increase the activation of rectus femoris when performed jump landing. The greater muscle activation can improve the musculotendinous and joint stiffness , reduce the phase of amortization in the stretch –shortening cycle and thus improve performance in eccentric – concentric actions such as counter movement jumps. There was also a study which mentioned that the benefits of eyes closed when performing balance training. The researchers noted that better concentration and through that the faster reaction of a joint stability and muscle activation[(7)]. Furthermore, **Heitkamp** and colleagues expressed that the improvement in static balance was because of the effect of training on reflex control of muscle activity when perform the exercise in close kinematic chain.The gain in strength, intramuscular and intermuscular coordination and activation of agonist able to help in stabilization of the extremities and lastly static balance improved. **Oliver** and colleagues stated that unstable surface training results in improve core strength and it had direct relation with dynamic balance[(8)]. Besides that, experienced athletes manage to have better ability of balance through neurological adaptations that depend less on `visual and focus more on proprioception inputs[(9)]. The reason for improvement in static balance can be due to effect of training on reflex control of muscle activity when exercising in close kinematic chain. The gain in strength, improved intramuscular & intermuscular coordination & more activation of agonists helps in achieving stabilisation of extremities & thus improves static balance[(10)]. **Dootchai Chaiwanichsiri et al** demonstrated that concentric & eccentric muscle contractions, proprioception , coordination as well as postural control involved during various exercises of wobble board balance training program may have improved static balance of athletes[(11)] The reason for improvement in dynamic balance may be due to similar pattern of movement to control body weight as in exercise program & in modified star excursion balance test as one foot is planted & other will reach in different directions .[(12)]. Also training on unstable surface undermines the principle of specificity of training and poses specific demands and thus may improve dynamic balance in these athletes[(13)]. The study done by **Gretchen et al** concluded that unstable surface training results in improved core strength and in previous studies it has found that core strength has direct relation with dynamic balance. Thus, the improved core strength result in increased score in modified star excursion balance test[(8)]

According to my study,Agility was measured using mini zig zag drill test and balance was measured by using star excursion balance test, concluded that the treatment group experienced a significant decrease in mini zig zag drill test and increase in star excursion balance test and thus an improvement in agility and balance .It has been documented widely in literature that consistent activity and training of the lower extremities influence the reaction time, proprioception and muscle activation of the ankle musculature. The training of lateral ankle muscles will enhance reaction and proprioception influences of the lower extremity and will result in improved postural control.

When the study was conducted the difficulty faced by the individuals while performing the star excursion test were lost balance and so trials were to be given. Initially, while performing single leg stance the individuals lost balance and they needed assistance to prevent any falls so support was given but in subsequent treatment sessions the problem was resolved as the individual started gaining balance. While performing single leg squats, balance was an issue and the individual could not gain the required degree of knee flexion (30^o-40^o). While performing single leg stance with power dribbling and tandem stance with power dribbling were dual task activities so it was again difficult for the individual to concentrate and do both the tasks with accuracy. Single leg stance with throwing the ball posed the same issue of maintaining balance. Jumping on two feet and landing on one feet had a danger of getting the single leg stance feet injured. Jumping on two feet and landing on one feet and turning 180^o along with that had a risk of injuring the feet as well as the back. When the individuals

were asked to rotate the wobble board and they could not initially maintain the balance and had a fall of risk associated.

It was difficult for the individual to maintain the balance without prior trials.The presence of significant improvement in agility and balance may also be attributed to neurological adaptation to activity and proprioceptive action of the trained joints and soft tissues. Another factor that might have played role in improvement could be motor recruitment.[(14)]

Group A is more effective than group B , the only main difference between both the groups was the use of wobble board. As group B had to exercise on more challenging surface the results are less than group B. Group A was made to do all the exercises on a stable surface, so the balance of the individual was less challenged and to maintain the balance along with performing exercises became a dual task activity which otherwise a difficult thing to be done in group B. Whereas the group A did all the exercises on a stable surface which was comparatively easy and less challenging.

According to **Potteiger et al**The improvement in muscle performance following plyometric training is most likely due to a combination of enhanced motor unit recruitment patterns and increased muscle fiber cross-sectional area.[(15)]. According to **Craig**, neural adaptations usually occur when athletes respond or react as a result of improved co-ordination between the CNS signal and proprioceptive feedback[(13)]. In plyometric training, the amortization phase between eccentric and concentric movements is shortened, allowing greater power production[(16)]. By taking advantage of stored elastic energy and the stretch reflex, the muscle is capable of performing more work in the concentric phase. This would allow for improvements in sport performance[(17)]. The authors suggested that altered feedback of mechanoreceptors from balance training may lead to central nervous system reorganization processes in terms of sensorimotor integration and, subsequently, to alterations of motor response (adaptations of neuromuscular control)[18].

In the conclusion, the findings of the current study revealed that there were significant differences of static balance and dynamic balance between both the groups after the four weeks sport specific balance training program and balance training program. Therefore, this study should able to raise up the awareness of the importance of balance training to their normal training routine and thus helped to reduce the developing trend of acute musculoskeletal injuries among athletes over a period of time.

V. Conclusion

This study concluded that a 4 week of sports specific balance training program is more effective than balance training program in improving balance and agility in basketball players.

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