Comparative Analysis of Effectiveness of Conventional Proprioceptive Training and Multistation Proprioceptive Training on Vertical Jump Performance in Indian Basketball Players

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Abstract

The purpose of the study is to investigate whether conventional (wobble board) proprioceptive training or multi-station proprioceptive training is an effective way to improve vertical jump performance. The research study included 30 basketball players divided into the two groups, Group A (n = 15) and Group B (n = 15). The group A underwent the wobble board proprioceptive training program lasting for four weeks. The group B was administered the multi-station proprioceptive training program lasting for four weeks. Both the training programs consisted of one-leg and double-leg static and dynamic balance drills. The demands and duration of those exercises increased progressively. The vertical jump height was estimated by Sergeant Jump Test at the beginning, after second week and at the end of the experiment. The results of this study indicate that Multi-station training showed greater improvements as compared to the conventional balance training and the results were significant at $p<0.01$. Multi-station training consisted of gradually progressive activities on exercise mats, wobble boards, mini trampoline, thera – band and walking on uneven surface while the conventional training consisted of training on wobble boards.

KEY WORDS: Proprioceptive Training, Multi-Station Proprioceptive Training, Wobble Boards, Thera – Band

Introduction

Sports today is becoming increasingly scientific and elite athletes rely as much on technique as on training. With the consequent raising of the bar and narrower winning margins, maximizing performance while avoiding injury requires continuous physiological monitoring of athletes during both training and competitions. According to *Matavulj et al (2001)*, importance of jumping performance in various kinesiologically related fields is caused by several reasons. First, jump height per se is important for success in different sport games and other athletic competitions. Second, different kinds of vertical jump served as a very popular model for studying various biomechanical and neuro-physiological phenomena. Finally, it is widely accepted that the jump height represents a good predictor of muscle power and, therefore, various kinds of vertical jumps have been often employed as standard tests of movement performance *Matavulj et al (2001)*.

Proprioception training, along with strength and flexibility training, is believed to be essential to the success of most rehabilitation programs (*Kristen et al, 1997)*. According to *Ya-Wen Liu, et al (1997),* proprioception can be defined as the conscious awareness of limb position and movement, and is a specialized variation of the sensory modality that encompasses the sensation of joint movement (kinesthesia) and joint position (joint position sense) *(Lephart et al. 1992)*. Proprioception is generally defined as the ability to assess a respective limb's position without the assistance of vision. Proprioception is governed by central and peripheral mechanisms that come mainly from muscular receptors, but also includes tendinous, articular and cutaneous receptors (*Ya-Wen Liu et al, 1997)*.

Team sport athletes, such as an American football lineman, a basketball centre, or rugby forward, require a balance of strength, power, and hypertrophy for success, and have different requirements to the specialist needs of athletes such as power lifters or bodybuilders. The increase in strength for vertical jump is therefore essential for an athlete playing basketball. History of different researches in this field of sport sciences have given their conclusion suggesting that individually different training improves strength but combination of different techniques such as trampoline training, thera-band, wobble board etc. Multi station Proprioceptive training can be incorporated for improving the vertical jump. Multi-station training provides differential grading and can be used to break monotony of conventional exercise. Proprioception training can also be used for prevention of recurrent injuries of lower limb. Multi-station exercise, a low frequency exercise, is easy to integrate into normal training routines.

Materials and Methods:

Thirty subjects who were regularly playing basketball were included in the study based on the inclusion and exclusion criteria. The inclusion criteria were; age – 14 – 20 years, only male candidates were considered for the study, players playing basketball regularly from last 1 year at school level. The exclusion criteria were; - presence of pain in any part of upper limb, lower limb, trunk or body which can interfere in training session, - players who had attended any type of proprioceptive training in last one year, - any Cardio-respiratory disorder, audio–visual disorder, any medical condition due to which athlete is on medication during course of the study, any surgical intervention in last 6 months. The subjects were randomly allocated to the two groups, Group A (n=15) and Group B (n=15). The group A underwent the wobble board proprioceptive training program and group B received multi-station proprioceptive training program lasting for four weeks.

Procedure

Testing: Baseline values were measured for the vertical jump height using the Sergeant Jump test *(Shaji and Saluja, 2009)*. In this test, player was asked to stand side on to a wall and reache up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips was marked, this was called as standing reach. The player then stood away from the wall, and jumped 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 was taken as the score. The best of three attempts were recorded. The readings were taken in centimetres (cms).

Training

Group A:- This training was given for 4 weeks, 3 days/week. The proprioceptive experimental program was conducted with balance board followed by 5 to 10 min warm-up program prior to training which included running, jumping and mild stretching to avoid any injury. The balance board that was used consisted of a wooden disk 16 inches in diameter with a 4-inch half sphere attached to the bottom. The sphere allowed approximately 17° of angulations in all planes. On the wobble board the progressive increase of load was done: according to the protocol enlisted in table 1. In one training unit 4 balance board tasks had been accomplished.

Table 1: conventional training protocol *(McGuine, and Keene, 2006).*

Phase	Surface	Eyes	Exercise
I	**Floor**	**Open**	**Single-leg stance**
Week 1		**Open**	**Single-leg stance while swinging the raised leg**
		Open	**Single-leg squat (30°-45°)**
		Open	**Single-leg stance while performing functional activities (dribbling, catching)**
		Closed	**Single-leg stance**
		Closed	**Single-leg stance while swinging the raised leg**
		Closed	**Single-leg squat (30°-45°)**
II	**Board**	**Open**	**Single-leg stance**
Week 2		**Open**	**Single-leg stance while swinging the raised leg**
		Open	**Single-leg squat (30°-45°)**
		Open	**Double-leg stance while rotating the board**
III	**Board**	**Closed**	**Single-leg stance**
Week 3		**Closed**	**Single-leg stance while swinging the raised leg**
		Closed	**Single-leg squat (30°-45°)**
		Closed	**Double-leg stance while rotating the board**
IV	**Board**	**Closed**	**Single-leg stance while rotating the board**
Week 4		**Open**	**Double-leg stance while performing functional activities (dribbling, catching)**
		Open	**Single-leg stance while performing functional activities (dribbling, catching)**
		Open	**Hopping and Jumping**

Fig. 1: Single limb stance with eyes closed

Fig. 2: Single limb stance on wobble board

Group B:-

This training was given for 4 weeks, 3 days/week. Subjects started each exercise period with a 5- to 10-min warm-up program prior to training which included running, jumping and mild stretching to avoid any injury. The exercise period took 20 min, and single exercises were performed for 45 seconds followed by a 30-seconds break where subjects moved over to the next station. The whole program was performed twice to exercise both feet in the same way. In the first session, the correct posture of the lower leg of the subjects was controlled

(slight external rotation of the foot, slightly flexed knee, and the patella over the metatarsophalangeal joint) during the exercise. The intensity of the 4-wk training period was increased by small modifications for each station every wk. The main goal of this program was to generate a wide variation of different stimuli for strength and coordination.

Stations:

- Exercise mat: - A PVC shrink wrapped with carrying net exercise mat with low thickness was used. The mat of dimensions (H) 0.95cm, (W) 60cm, (L)120cm was used. The exercise program included – double limb stance with eyes closed, single limb stance with open and closed eyes.
- Ankle disk: - An ankle disk that was used consisted of a wooden disk 16 inches in diameter with a 4-inch half sphere attached to the bottom. The sphere allowed approximately 17° of angulation in all planes. The exercise program included – maintain balance on an ankle disk in single-limb and double limb stance.
- Exercise band (Thera-Band ®):- A blue coloured exercise band (Thera-Band ®) was used to maintain balance in single-limb stance with abduction of the contra-lateral leg against resistance of an exercise band.
- Mini trampoline (Cosco®):- A mini trampoline (Cosco®) with 40" diameter made up of heavy gauge steel with spring attached was used. The exercises included - maintainining balance in single-limb stance with eyes open and closed, jumping, hopping.

Uneven walkway (customized):- the uneven walkway was customized with help of tennis balls as a station of multi station training to experience different surfaces in walking.

Fig. 3: Single limb stance on exercise mat with eyes closed

Fig. 4: Jumping on mini trampoline

Statistical Analysis: The mean and standard deviation of all the variables were analysed. Data analysis was done with the help of SPSS for windows version 16.0 in order to verify the investigations of the study. Unpaired t - test was applied to find out whether the improvements in vertical jump height were significant. The significance level set for this study was 95% ($p<0.05$).

Results & Discussion:

The results of the current study depict that multi-station proprioceptive training is more effective in improvement of vertical jump in basketball players. The

improvement in vertical jump was found to be significant at $p<0.01$ level.

Table 1: Comparisons of improvement in vertical jump height of group A and group B at 0th week, 2nd week, 4th week.

Weeks	Vertical jump height of group A	Vertical jump height of group B
0^{th} week	35.07 ± 7.68	40.73 ± 9.99
2^{nd} week	39.67 ± 6.88	48.87 ± 9.88
4^{th} week	46.00 ± 7.96	55.60 ± 9.36

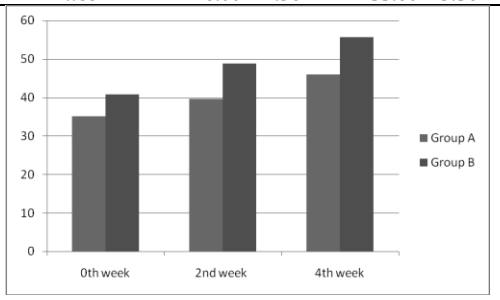

Figure 1: comparisons of improvement in vertical jump height of group A and group B at 0th week, 2nd week, 4th week.

The aim of the study was done to compare the effectiveness of conventional (wobble board) proprioceptive training and multi-station proprioceptive training on the vertical jump performance in basketball players. The results of the conventional proprioceptive training and multi-station proprioceptive training shows 10.93 mean increase in vertical jump in group A and 14.87 mean increase in vertical jump in group B. There was significant improvement in vertical jump height in both groups. Improvement in vertical jump with multi-station proprioceptive training was found to be greater in group B. *Gruber and Golhofer (2004)* had concluded in their study that the possibility of proprioceptive training influence on the neuromuscular system may be 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. Previous researches have shown that the proprioceptive training affects the increase in strength of the flexor and extensor muscles of foot *(Trop and Askling, 1988)*. It also affects the increase in the strength of the muscles on the back side of the thigh *(Heitcamp et al, 2001)*. The increase in strength of leg extensor muscles along with the inhibition of stretch reflex can be the reason for the improvement in vertical jumping performance. The proprioceptive training was intended to develop the strength of muscles and the multi-station training would also have helped to increase both the strength and coordination. Studies also suggest that proprioceptive training would help to increase the strength. As the explosive force generation in vertical jumping performance is influenced by the rapid transfer from eccentric to concentric muscle work (stretch-shortening cycle), it is possible that the proprioceptive training may have an effect on the quicker generation of strength as well as on the higher rate and early inclusion of motor units *(Gruber and Golhoffer, 2004)*. *Ya-Wen Liu et al, (2005)* proposed that training on multi-station challenged more muscle and further opined that proprioception is governed by central and peripheral mechanism that come mainly from muscular receptor, but also includes tendinous, articular and cutaneous receptors. The respective roles of these various sources of afferent information have been debated, but it is now

recognized that muscular receptors have the most important part in the elaboration of limb proprioception *(Bouet and Gahery, 2000)*. This role for muscular receptors indicated that modifying the functional state of the muscles could affect the precision of position sense *(Ya-Wen Liu et al, 2005)*.

Eric and Rosenbaum (2001) conducted a study, in which they used multi-station training on 12 different surfaces. They suggested that low frequency exercise is easy to integrate into normal training routines. They found improvement in joint position sense and limited postural sway and a stable base which helped in jumping high. They further concluded that multi-station training reduces reaction time that helps in simultaneous release of force and jump high.

Limitations: While designing the present study it was tried to keep the limitations to the minimum. This study had some of its own limitations which can be summarized as: Only school level basketball players were taken so the result of this study could not be generalized for all population, the study was based on the data collected from males only; for the generalization of the data the study should be conducted on female players, and sample size included for the study was small. Future studies in this area may include a study which can be designed to compare the effect of proprioceptive training on stability trainer and wobble board on other performance variables in basketball players, and can be designed for the 3 – D analysis of balance affecting vertical jump, and study should be designed to analyze the effect of proprioceptive training on postural sway, joint position sense and reaction time.

Conclusions: The results of the current study indicate that Multi-station training showed higher improvements as compared to conventional balance training. Thus, null hypothesis was rejected and experimental hypothesis was accepted.

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