

Effectiveness of proprioceptive neuromuscular facilitation versus strengthening of lower extremity in dancers performing drop landing

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ABSTRACT

Objective: The aim of the study is to determine the effect of proprioceptive neuromuscular facilitation versus strengthening of lower extremity (LE) in dancers performing drop landing. **Background of the Study:** Dancers performing drop landing causes fatigue and pain in LE. Fatigue presents as a potential risk factor for injury and also reduces the endurance in dancers. Activation patterns of the lower limb muscle groups have been consistently reported to alter in response to fatigue during landing tasks. Proprioceptive neuromuscular facilitation technique is more effective in producing long-term flexibility overtime and endurance. Strengthening will improve the muscle endurance. The purpose of the study was to increase the endurance and performance level. **Methodology:** The experimental study was conducted among the modern dancers for the duration of 8 weeks. 20 subjects were randomly selected from dancers and separated into two groups equally with the age group between 16 and 21 years. The study was done in ACS Medical College. Only dancers were included with drop-landing performance. The standing stroke test was used to find the endurance level. **Procedure:** A total of 20 selected subjects were taken based on the standing stroke test and will be divided into two Groups A and B. Proprioceptive neuromuscular facilitation technique was given to Group A and muscle strengthening was given to Group B for the duration of 8 weeks. Pre-assessment was taken at the beginning of the study and post-assessment was done at the end of 8th week. Assessment was done at every month end. **Results:** There was a significant difference in the pre-test and the post-test values of standing stork test (SST) between the Group A and Group B. On comparing both groups of their pre- and post-test values of SST, Group A shows higher mean value (28.3) than Group B (25.6) where $P < 0.001$ which is highly statistically significant. **Conclusion:** This study shows that the proprioceptive neuromuscular facilitation technique increases the endurance and performance in dancers performing drop landing than the strengthening of the LE.

KEY WORDS: Isotonic-resisted exercise, Proprioceptive neuromuscular facilitation, Standing stork test

INTRODUCTION

“Dance is human movement created and expressed for an esthetic purpose.” Dancers also acknowledge that training is the most important factor in the advancement or inhibition of their career.^[1] Dance is an integral part of human nature that is present in many culture and as performing art.^[1] Dancers perform many types of jumping in their performance for artistic purpose. From the esthetic point of view, dancers are instructed to land on the floor as quietly as they can during their training and practice. In addition, it is speculated that quiet landing can retain some potentials to prevent dance injury.^[2] Dance is a popular form of physical

activity.^[1] Dance is a physically demanding activity, with almost 70% of all injuries in dancers occurring in the lower extremity (LE). In dance training, dancers are trained to keep their upper body in upright position during movements. LE strength is not only essential for the performance of explosive maneuvers such as leaps and jumps but is vital for the balance and postural control in various balletic positions such as arabesque and attitude. Jumping and landing tasks are integral aspects of dance technique. A dancer’s ability to perform jumps with agility and power in conjunction with graceful controlled landings is testament to the athleticism required in elite dance performance. It is supposed that dancers keep their upper body in the same ways even during jumping or landing. Fatigue may reduce a dancer’s ability to maintain the muscle synergies required for stable human movement. Therefore, fatigue presents as a potential risk factor

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for injury in dancers. Activation patterns of the quadriceps and hamstrings muscle groups in athletic populations have been consistently reported to alter in response to fatigue during landing tasks.^[3] PNF techniques were developed by physical therapist in the 1950s to treat the patient who was weakened by diseases.^[4,5] Proprioceptive neuromuscular facilitation combines isometric, static, and passive stretching. Stretching has been shown to have significant effects on flexibility, which, in turn, could promote enhanced performance.^[6] PNF is a method of flexibility training that can reduce hypertonus, allowing muscles to relax and lengthen.^[7] Perform it by passively stretching a muscle, isometrically contracting it against resistance in the stretched position, and passively stretching it through the resulting increased range of motion. It facilitates flexibilities, strength, and coordination.^[8] It is an advanced form of flexibility training that also helps improve strength. In our study, we will be using the contract-relax technique, which is a passive stretch followed by a contraction of the antagonist muscle, followed by another passive stretch.^[9] PNF techniques are effective for producing short-term increases in flexibility.^[10,11] The derivation of the term isotonic means constant (isotension)^[12] and is technically inaccurate since the force required to lift a weight changes throughout the range of motion. Other terms such as isoinertial^[13-15] and dynamic constant external resistance^[16] have been used to avoid the inaccuracy of the term isotonic. Isotonic exercise is a form of active exercise in which muscles contract and cause movement. There is no significant change in resistance throughout the movement, so the force of contraction remains constant. Such exercise greatly enhances joint mobility and helps improve muscle strength and tone. Large group of muscles is mainly concentrated to strengthen. Quadriceps strengthening exercises are designed to improve the strength of the quadriceps muscle. Resistance exercise has been practiced for centuries,^[17] and despite the pioneer scientific work by DeLorme and Watkins >60 years ago.^[18,19] The quadriceps comprise four muscle bellies, one of which is the vastus medialis obliquus (VMO). The VMO is very important in quadriceps exercises. They contract together to help flex (or lift up) the hip and extend (or straighten) the knee. The central hypothesis in this study is that quadriceps femoris muscle strength may vary in multiple angles. The biceps femoris, semimembranosus, and semitendinosus muscles on the back of your thigh are collectively referred to as the hamstrings. These facilitate both hip extension and knee flexion ranges of motion. A variety of exercises can be performed to build and strengthen the hamstrings, which will help to perform activities such as bending over, squatting down, and walking without any trouble and may reduce your risk for injuries. Most of these powerful and harmonious movements are caused by flexion and extension of the knee in

different degrees of motion. Knee injuries caused by sudden jumps and maneuvers to dodge the opponent, these could all cause significant pressure or strain on the knee joint and its related muscles. The knee joint is, therefore, one of the most vulnerable joints in the body. Citake and Yokse (2011) studied that there is a significant difference in static single-leg balance in the standing position. As physical training for fitness and skill in dance is similar to that experienced by athletes, an improper program can, if not recognized, result in overtraining, injuries, and decreased performance. Standing stork test (SST) is valid and highly reliable test that used to assess the endurance of the lower limb during pre-test and post-test.

MATERIALS AND METHODS

The experimental study was conducted among the modern dancers for the duration of 8 weeks. Subjects were randomly selected from dancers and separated into two groups equally with the age group between 16 and 21 years. The study was done at Faculty of Physiotherapy, Dr. MGR Educational and Research Institute. 45 male and female subjects were taken in which 15 dropped out finally 30 was taken for study. Group A treated with proprioceptive neuromuscular facilitation technique. Group B treated with general isotonic resisted exercise for the duration of 8 weeks. Pre-assessment was taken at the beginning of the study and post-assessment was done at the end of the 8th week.

Exercise Intervention

Group-A: Proprioceptive neuromuscular facilitation technique

Contract relax

Contract-relax stretching, this technique was used to gain length in shortened muscles, therefore, increasing range of motion and flexibility. The subject was asked to contract against resistance provided by me for 10 s, then to relax for 5 s. This resets the connection between the brain and the muscle spindles (stretch sensors in the muscles), allowing the muscle to lengthen more. The exercise was repeated 3–5 times.

Group-B: Quadriceps muscle groups

Static inner quadriceps contraction

Subject is asked to tighten the muscle at the front of the thigh (quadriceps) by pushing the knee down into a towel. Placed the fingers on the inner quadriceps to feel the muscle tighten during contraction and asked to hold for 5 s and repeat 10 times as hard as possible pain free.

Resistance band knee extension in sitting

Subject is asked to begin this exercise in sitting with the knee bent and a resistance band tied around the ankle as shown and by keeping the back straight,

slowly straightens the knee by tightening the front of the thigh (quadriceps), then slowly returned back to the starting position. Performed three sets of 10 repetitions provided the exercise were pain free.

Hamstring Muscle Groups

Resistance band hamstring curl

Subject is taught to begin this exercise lying on the stomach with a resistance band tied around the ankle as demonstrated and slowly the knee is bent and back of the thigh (hamstrings) is tightened. Performed three sets of 10 repetitions provided the exercise were pain free.

Calf Muscle Groups

Calf raises overstep

Subjects begin this calves strengthening exercise by standing with the heels dropped below the level of a step. Make sure that the subject hold something for balance. Slowly move up onto the toes, raising the heels as far as possible and comfortable without pain, tightening calf muscles, then slowly lower down the ankle. Perform three sets of 10 repetitions provided the exercise are pain free.

Test Measurements

SST

The objective of this test is to monitor the development of the athlete's ability to maintain a state of equilibrium (balance) and endurance in a static position for prolonged duration. Analysis of the result is by comparing it with the results of previous tests. It is expected that, with appropriate training between each test, the analysis would indicate an improvement. It is highly valid and reliable.

Data Analysis

Table 1 reveals the mean, standard deviation (SD), *t*-test, degree of freedom, and *P*-value of the SST between Group A and Group B in pre-test and post-test. This table shows that there is no significant difference in pre-test values of the SST scale between

Group A and Group B ($*P > 0.05$). In SST there is a statistically highly significant difference between the pre-test and post-test values within GROUP A and GROUP B ($***P \leq 0.05$).

Table 2 reveals the mean, SD, *t*-value, and *P*-value of the SST between pre-test and post-test within Groups A and B. In SST, there is a statistically highly significant difference between the pre-test and post-test values within Groups A and B ($**P \leq 0.001$).

RESULTS

There is a significant difference in the pre-test and post-test values of SST between the Group A and Group B. On comparing both groups of their pre- and post-test values of SST, Group A shows higher mean value (28.3) than Group B (25.6) where $P < 0.001$ which is highly statistically significant. When the inter-group mean values of SST were analysed. The mean values of Group-A pre-test mean SST (21.4) and post-test mean (28.3). The mean values of Group-B pre-test mean SST (21.8) and post-test mean (25.6).

DISCUSSION

The purpose of the study was to determine the effect of proprioceptive neuromuscular facilitation versus strengthening of LE in dancers performing drop landing. Based on the selection criteria, 20 subjects were participated in this study. The outcome measures were SST to test the endurance. The PNF technique was the treatment strategies for the dancers to prevent the fatigue and to increase endurance and performance. Ferber *et al.* reported that greater ROM improvements after PNF compared with SS within a single session. The strengthening exercise program also aims at improving the endurance and performance. This exercise program includes isotonic-resisted exercise. The values of SST pre-test and post-test were compared by the mean difference. From the data analysis that both groups were considered to be beneficial in improving endurance and performance.

Table 1: Comparison of SST between Group-a and Group-b in pre- and post-test

SST	PNF	Strengthening	<i>t</i> -test	DF	Significance
	Mean±SD	Mean±SD			
Pre-test	21.4±2.41	21.8±3.08	-0.323	18	0.750*
Post-test	28.3±2.16	25.6±2.63	2.506	18	0.022***

* $P > 0.05$, *** $P \leq 0.05$. SST: Standing stork test, DF: Degree of freedom, SD: Standard deviation

Table 2: Comparison of SST scale within Group-A and Group-B between pre- and post-test values

SST	Pre-test	Post-test	<i>t</i> -test	DF	Significance
	Mean±SD	Mean±SD			
Group A	21.40±2.70	28.3±2.72	-7.257	19	0.000**
Group B	21.80±3.08	25.60±2.63	-3.896	9	0.004**

Group A: PNF, Group B: Strengthening. ** $P \leq 0.001$. SST: Standing stork test, DF: Degree of freedom, SD: Standard deviation

Group A (PNF technique) significantly shows more improvement than Group B (strengthening exercise).

CONCLUSION

In this experimental study, it has been concluded that proprioceptive neuromuscular facilitation technique shows greater significant than isotonic exercise among modern dancers of drop-landing performance. Group A (PNF technique) significantly shows more improvement than Group B (strengthening exercise).

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