



Original Research Article

Comparative Effect of Wobble Board and Single Leg Stance Exercises on Ankle Joint Proprioception in Asymptomatic Subjects

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Received: 14/04/2014

Revised: 06/05/2014

Accepted: 13/05/2014

ABSTRACT

Background: Ankle sprain is one of the most common injuries of lower limb associated with sports and daily activities. Therefore studies on how to best prevent these injuries from occurring are essential.

Objectives: To devise an exercise program that is effective and can be easily integrated into normal training routines for preventing occurrence of ankle injuries.

Methods: This is a pre-test post-test experimental design, conducted in the Department of Physiotherapy (Guru Jambheshwar University of Science & Technology, Hisar, Haryana). 60 subjects (both male and female) aged 18-25 years participated in this study. Their Joint Position Sense (JPS) was measured by Angle of Reproduction Test.

Results: Data analysis was done using SPSS software v.15 found that there was no significant difference between the pre and post readings in Group A and Group C but significant difference was present in Group B ($p < 0.05$).

Conclusion: Wobble board training is more effective than single leg stance and theraband exercises in improving proprioceptive balance. Thus, it can be incorporated in the training program of normal individuals especially athletes to prevent ankle injuries.

Keywords: Wobble board, Single leg stance, Theraband exercises, Joint position sense (JPS)

INTRODUCTION

Ankle sprains, typically ankle inversion injuries are common orthopedic conditions frequently evaluated and treated by health care providers. ^[1] It has been estimated that the incidence is about one ankle inversion per 10,000 people per day. ^[2] Ankle sprains are the most common injuries occurring during sports and probably account for the greatest loss of playing time of any injury. ^[1, 3, 4] However,

it can also occur during normal daily activities such as stepping off a curb or slipping on ice. Inversion injuries are more common than eversion sprains, as approximately 85% of ankle injuries presented at a sports medicine clinic in the US were injuries involving the lateral ligaments. ^[3] The anterior talofibular ligament alone was torn in two-thirds of those inversion injuries, however this percentage can be much higher when

considering the population as a whole. [5] The calcaneofibular and the posterior talofibular ligaments are seldom ruptured alone. [2]

Ankle joint instability might result from mechanical or functional instability of the ankle joint. Mechanical instability refers to objective measurements of ligament laxity, whereas functional instability is defined as recurrent sprains. Casual factors include a proprioceptive deficit, muscular weakness, and/or absent coordination.

Lateral ankle sprains represent one of the most common injuries associated with sport and activity, therefore studies into how to best prevent this condition from occurring are being recognized as essential. Research related to ankle injuries has progressed from topics related to etiology, assessment and treatment of this condition, to literature more recently that includes a strong focus on injury prevention. Injury prevention research can be conceptualized as a four-step process firstly establishing the extent of the injury problem secondly, establishing the etiology and mechanism of sports injuries thirdly, introducing a prevention program and fourthly assessing its effectiveness by repeating step one. [6]

For rehabilitation after injury or prevention of re-injuries, proprioceptive training has been recommended throughout the literature. [7] The effects of proprioceptive exercises have been evaluated with test procedures regarding angle reproduction, [6, 8] postural sway [6, 9] or muscle reaction time. [10,11] Only a few investigators used more than one test procedure simultaneously, and there is also some controversy about the actual benefit of proprioceptive exercise programs regarding the different testing procedures.

Numerous studies have done to find out the effect of balance and proprioception exercises, for preventing chances of ankle injuries. Therefore, the purpose of this study

is to devise an exercise program that is effective and can be easily integrated into normal training routines for preventing occurrence of ankle injuries.

MATERIALS AND METHODS

The study design was a pre-test post-test experimental design. The study was conducted in the Department of Physiotherapy (Guru Jambheshwar University of Science and Technology, Hisar, Haryana, India). 60 subjects who fulfilled the inclusion and exclusion criteria were divided equally into three groups by convenient random sampling. Total duration of the study was 4 weeks. An informed consent was taken from each subject prior to participation. Before starting the exercise program, the Joint Position Sense (JPS) was measured by Angle of Reproduction Test. The divided groups were named according to the training, as follows:

Group A: Thera Band alone

Group B: Wobble Board and Thera Band

Group C: Single Leg Stance and Thera Band

Inclusion Criteria:

- Age group between 18-25 years
- Both sex
- No history of ankle sprain in past 6 to 12 months
- BMI between 18.5-24.9 kg/m²

Exclusion Criteria:

- Pre-diagnosed general medical conditions (e.g. Hyperthyroidism, hypertension, diabetes)
- Prior surgery to distal tibia, fibula, ankle joint or foot
- History of lower limb fractures or dislocations
- Acquired or congenital deformity of lower limb
- Pregnancy
- Subjects unable to comply with the exercise program

Angle of Reproduction Test: Petrella et al found that angle of reproduction test is highly reliable test for assessing the Joint Position Sense (JPS).^[12] Its test-retest reliability is 0.88. During this test the subjects were asked to sit in high-sitting position. Subjects were unable to see their feet throughout the examination and had their eyes closed to concentrate on the measurements. Initially, the foot was brought into 30° plantar flexion by therapist and was held for 2 seconds. Then it was brought back in neutral position and the subject was asked to reproduce that angle of plantar flexion. The measurement was done by electro-goniometer. The difference of all predefined and reproduced angles were recorded as pre-training score and after 4 weeks the post-training scores were recorded and compared.

Group A (Theraband Exercises)

In this group, the subjects were trained 3 times per week for 4 weeks. Each exercise consisted of 3x15 repetitions with 2 minutes rest between each set. The exercises performed were Front pull, Back pull, Crossover, Reverse crossover.

Group B (Wobble Board + Theraband Exercises)

In this group, the subjects were trained 3 times per week for 4 weeks. Each exercise consisted of 3x15 repetitions with 2 minutes rest between each set. Following exercises were done:

1. Stand with feet parallel on the board; rock the board forward and backward.
2. Stand with feet parallel on the board rock the board from side to side.
3. Stand with feet wide apart on the board rock the front of the board from side to side in a circulating movement.

If balance can be maintained in these exercises without losing stability of the board, then complete the same with the eyes closed.

Along with these, the subjects also performed the exercises of group A.

Group C (Single Leg Stance + Theraband Exercises)

Participants were individually instructed on the proper testing position standing on one leg and raising the opposite knee (foot about 6 inches off the floor), hands on iliac crests, head up, and eyes closed. Participants were also informed about possible errors. Errors were scored if the participant (1) opened their eyes, (2) stepped, stumbled, or fell out of the test position, (3) removed their hands from their hips, or (4) remained out of the test position for longer than 5 seconds (Domingo, 2004; Finnoff & Mildenerger, 2005).

The training sessions were conducted 3 times a week for 4 weeks. Training sessions consisted of six bouts of 20 seconds each, of single-leg stance (dominant leg) on a foam pad with 20 second rest periods between bouts.

Along with these, the subjects also performed the exercises of group A

Data Analysis

Analysis of data collected of JPS of 60 subjects was done by suitable statistical analysis tests by using SPSS software version 15 in order to verify the investigation of the study. The result were considered significant if the $p < 0.05$

One way ANOVA was used to analyze inter-group differences of JPS before and after performing the wobble board, single leg stance, and theraband exercises.

Paired sample t-test was used to compare the intra-group difference in wobble board, single leg stance, and the group only performing theraband exercises.

RESULTS

Table 1: Between Group Analysis of Age and BMI

	AGE Mean + SD	BMI Mean + SD
Group A	20.70 ± 1.95	21.37 ± 1.73
Group B	20.20 ± 1.51	21.10 ± 2.03
Group C	20.50 ± 1.50	20.58 ± 1.71

Between groups analysis of age and BMI showed that there was no significant difference between the three groups.

Table 2: Between group analysis of JPS before and after training

	Pre-Training JPS		Post-Training JPS	
	Mean + SD	p-value	Mean + SD	p-value
Group A	30.42 ± 3.62	0.831	29.09 ± 1.88	0.01
Group B	30.13 ± 2.80		28.15 ± 1.09	
Group C	30.73 ± 2.77		29.57 ± 1.26	

Between group analysis of JPS showed that there was no significant difference in the JPS readings before performing the training exercise but after performing the exercises, there was significant difference between them.

Table 3: Comparison of change in JPS within groups

		Mean	p-value
Group A	pre JPS – post JPS	1.33 ± 0.65	0.037
Group B	pre JPS – post JPS	1.97 ± 0.80	0.005
Group C	pre JPS – post JPS	1.15 ± 0.51	0.050

Within group analysis of JPS showed that there was no significant difference between the pre and post readings in Group A and Group C but significant difference was present in Group B.

Comparison of JPS among all three groups before and after training exercises

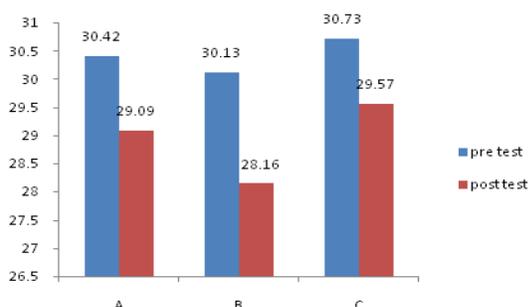


Fig.1. Comparison of JPS among all three groups before & after training exercises.

DISCUSSION

The aim of the present study was to investigate the effects of different exercise program for improving proprioceptive balance of ankle in asymptomatic subjects. The subjects in this study had similar baseline values of all dependent variables suggesting that all groups had homogenous group of subjects.

Proprioceptive exercises are used after injury and for the prevention of reinjury, however, they have also been advocated for the prevention of initial injury. [13] They are based on the hypothesis that ‘. . . residual functional ankle instability may be the result of damage to the afferent nerve fibres in the capsule and ligaments controlling reflexes that aid in the stabilisation of the ankle’. [14] These exercises often involve the use of such devices as tilt boards, ankle disks, bongo boards and the like, which demand activity of the musculature that pronates and supinates the foot. [13,14]

Our results indicate that ankle-strengthening exercises improve JPS in subjects with functionally unstable ankles. Theoretically, there are two possible sensory mechanisms that may have produced the change. It is possible that joint mechanoreceptors were stimulated by the motion of the exercise, resulting in an increased sensitivity.

We believe the more likely mechanism for our results was the muscle spindle. In addition to the sensory endings, the spindles also receive connections from static and dynamic gamma-efferent nerves, which enhance the afferent responses. [15,16] It is possible that the strength training may have increased gamma-efferent activity. The spindle may have been more sensitive to instantaneous stretch, resulting in greater acuity in sensing joint position. It is also possible that dynamic gamma efference

increased the sensitivity to the rate of length changes.

Combined strength and balance training has been shown to improve balance-board performance. [17] Unfortunately, because the training included both balance and strength components, it was not possible to determine the individual effects of either component.

CONCLUSION

Overall it can be concluded that wobble board training is more effective than single leg stance and theraband exercises in improving proprioceptive balance. Thus, it can be incorporated in the training program of normal individuals especially athletes to prevent injuries.

Limitations

1. Small sample size
2. No follow up of results taken in the long run
3. Study has been done in asymptomatic subjects so it has less relevance for symptomatic individuals.

ACKNOWLEDGEMENT

We are grateful to Prof. S.K Singh for his warm support and the volunteers who participated in this study.

Conflict of Interest: None declared

Ethical Clearance: We certify that this study has been approved by the relevant ethical committee.

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How to cite this article: Prakash S, Singh V. Comparative effect of wobble board and single leg stance exercises on ankle joint proprioception in asymptomatic subjects. *Int J Health Sci Res.* 2014;4(6):123-128.

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