

**EFFECTIVENESS OF ANKLE STRENGTHENING USING PILATES  
REFORMER VS. BALANCE BOARD TO IMPROVE BALANCE IN  
DANCERS**

An Undergraduate Research Scholars Thesis

by

CHLOE BERGERON, MADELEINE DARDEAU, OLIVIA GERWING and DANIELLE  
SCHRAER

Submitted to the Undergraduate Research Scholars program at  
Texas A&M University  
in partial fulfillment of the requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

May 2019

Major: Dance Science

# TABLE OF CONTENTS

	Page
ABSTRACT.....	1
ACKNOWLEDGMENTS .....	2
NOMENCLATURE .....	3
CHAPTER	
I.    INTRODUCTION .....	4
II.   METHODS .....	6
Participants .....	6
Testing Protocol .....	6
Intervention .....	8
III.  RESULTS .....	10
IV.  DISCUSSION .....	12
V.   CONCLUSION .....	14
REFERENCES .....	15

## **ABSTRACT**

Effectiveness of Ankle Strengthening using Pilates Reformer vs. Balance Board to Improve Balance in Dancers

Chloe Bergeron, Madeleine Dardeau, Olivia Gerwing, and Danielle Schraer  
Department of Health and Kinesiology  
Texas A&M University

Research Advisor: Christine Bergeron  
Department of Health and Kinesiology  
Texas A&M University

Research Advisor: Carisa Armstrong  
Department of Health and Kinesiology  
Texas A&M University

This study was conducted to analyze the alignment of various collegiate dancers' ankles in order to strengthen the muscles surrounding the ankle joint and improve balance. The research was conducted using a pre and post-test consisting of the Star Excursion Balance test and the Stork test. Participants from the Texas A&M dance program that did not have any lower extremity injuries in the six months prior to the study were randomly assigned to either the Pilates intervention group, balance board intervention group, or a control group who continued their regular training regimen. The participants met three times a week for five weeks to go through the intervention exercises. After the intervention period, a post test was conducted to collect data from the same tests used for the pre-test. It was predicted that the balance board group would have the greatest improvement because the exercises were fully weight bearing and challenged their balance more than the reformer group.

## **ACKNOWLEDGEMENTS**

We would like to thank our faculty advisors, Christine Bergeron and Carisa Armstrong, for their support and guidance throughout this research project. We would also like to thank the College of Education - Health and Kinesiology Department at Texas A&M University for allowing us the opportunity to conduct our research. Lastly, we would like to thank the TAMU dance department for allowing us to use their students as our subjects and our participants for making our research possible.

## NOMENCLATURE

SEBT      Star Excursion Balance Test

ST         Stork Test

# CHAPTER I

## INTRODUCTION

Balance and ankle stability are essential components for dancers to perform movements with correct alignment and to help prevent injury. Consequently, finding a way to increase ankle stability and improve balance time in dancers is important for their overall success. In general, “balance training is believed to be one of the principal constituent of rehabilitating an athlete with functional ankle instability.” (Davlin, 2004) Mhatre, Vilares, Stibb, Albert, Pickering, Marciniak, Kording and Toledo found that balance board in dancers, cross training is essential to keep the body in shape to perform. It is thought that “Regular technique class... does not always provide a sufficient conditioning program for prevention of injuries or skeletal imbalances often associated with the performance and rehearsal.” (Ahearn, 2006) This raises the question, *what is the best method of cross training for dancers to improve ankle stability and balance?* In search of the most effective training method, this study investigated two forms of common training methods for dancers, Pilates reformer and balance board. Based upon current research the “use of proprioceptive balance board program is effective” (Verhagen, van der Beek, Twisk, Bouter, Bahr & van Mechelen, 2004) in preventing ankle sprains. Although “there is weak support for the effectiveness of Pilates . . . this weakness is related to the lack of sound research methods employed in the published research.” (Bernardo & Nagle, 2006) Since Pilates is used as a training method by many athletes and more research is needed to determine its effectiveness on balance, exploring the potential benefits on the strength and stabilization of the ankle in comparison to another training method is useful.

The limited research raises many questions about the impact of cross training protocols on dancers' ankle stability and balance. Balance board training has been proven to increase balance and assist with ankle stability in some populations, but the research is non-existent in dancers. Currently, Pilates research does not support an improvement on balance in dancers. (Amorim, Sousa, Machado & Santos, 2011) However as stated by Bernardo and Nagle, this may be due to a lack in methods rather than a flaw in the Pilates method. These two training methods have not been compared in published research in regard to improving ankle stability and balance in dancers. Therefore, the goal for this study is to investigate which training method may increase overall balance in collegiate dancers.

## **CHAPTER II**

### **METHODS**

#### **Participants**

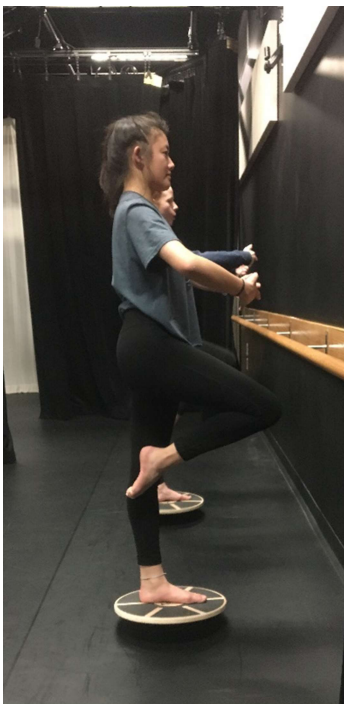
Initially, this study consisted of 22 of participants ranging from age 18-24 years old from a collegiate level dance program. Five subjects withdrew from the study due to missed training or intervention session and one was withdrawn from the study due to a foot injury, which occurred outside of the study. This left a total of 16 participants who completed the study. Participants were required to be enrolled in a ballet and/or modern technique class which met three times a week. Study participants also had to be free from a lower extremity injury in the past six months. An IRB committee approved this research and all participants signed a consent form.

#### **Testing Protocol**

The remaining participants were randomly divided into three groups; a balance board intervention group (n=4), a Pilates reformer intervention group (n=5), and a control group (n=7). The intervention groups performed exercises on the balance board or the Pilates reformer, which aimed at strengthening the ankles, and were geared towards a skill level for trained collegiate dancers. The control group continued their normal exercise regimen without any intervention or additional balance training. Before intervention began, a pre-test was conducted with the Star Excursion Balance Test (SEBT) in parallel and the Stork Test (ST) in parallel and external rotation for all three groups. For the SEBT, the subject stood on one leg in parallel on flat foot at the center of a taped star with their hands on their hips throughout the test. The subjects were expected to maintain balance and proper alignment of the standing leg as they reached the



gesture leg to the end of each arm of the star. Each participant started with a score of 10 for the SEBT test and received -0.5 for each infraction that totaled up for their final score. Infractions during the SEBT included losing balance such as hopping, hands dropping from the hips, touching the foot to the ground or pronating or supinating the standing ankle. For the ST, the subjects stood on one leg with the other leg in a passé position. The subject stood on a flat-foot as long as possible in parallel and external rotation for a maximum of thirty seconds. If the participants had an infraction while balancing, the time was recorded when the infraction occurred. Infractions could have been a break of the toe from the standing knee, losing balance and the toe touching the ground or a hop.



**Figure 1.** Participants on a balance board.



**Figure 2.** Participant on Pilates reformer.

## **Intervention**

The Pilates reformer group (n=5) and balance board group (n=4) did one week of training to learn the exercises they would be doing during the 4-week intervention study. The balance board group used a balance board, which is a circular board with half a sphere as the base to allow for movement in all directions and to challenge balance while the participant is standing upright, fully weight bearing (Figure 1). The Pilates reformer is a gliding bed that uses resistance springs to strengthen different parts of the body while the participant exercises in various positions (Figure 2).

Participants were taught the exercises and instructed on the mechanics, proper alignment and muscular engagement of the exercises. The training sessions lasted 15-20 minutes and were conducted three times over a one-week period. Following the one-week training session, participants performed 4 weeks of intervention. Each group followed the same exercise format including a Pilates movement principle mat warm up, exercises on the either the reformer or the balance board and ending the session with a single balance in parallel passé (Tables 1 and 2). The timing of the exercises for both groups were controlled using a metronome set at 25 bpm at 2/4 time. Intervention sessions were conducted by the same qualified instructor who lead the subjects through the exercises and ensured participants maintained proper alignment throughout.

**Table 1. Balance Board Exercises**

<b>Warm Up:</b>	<b>Plié in parallel (5x), plié external rotation (first position) (5x), plié roll up forced arch (5x), plié relevé (5x)</b>
<b>Exercise:</b>	Clockwise circles (5x), counter-clockwise circles (5x), single leg side-to-side (10x), passé relevé (10x) *(metronome set at 25 beats per minute in a 2/4 time)
<b>Balance:</b>	Parallel balance (30 sec), externally rotated balance (30 sec)
<b>Intensify:</b>	Did last set of balances without touching the barre.

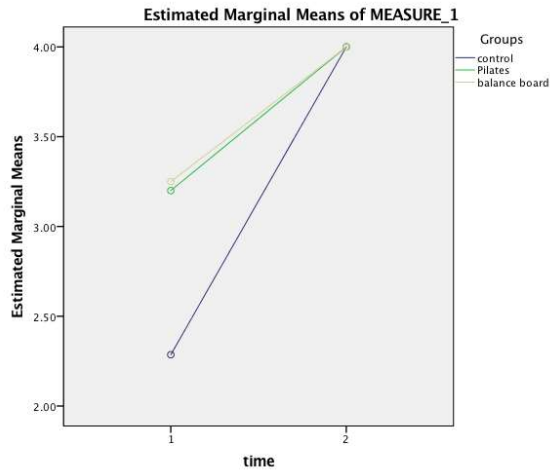
**Table 2. Pilates Reformer Exercises**

<b>Warm Up:</b>	<b>Plié in parallel (5x), plié external rotation (first position) (5x), plié roll up forced arch (5x), plié relevé (5x)</b>
<b>Exercise:</b>	Footwork [parallel toes (10x), externally rotated toes (10x), single leg heel raises (10x), prancing (20x)] *(metronome set at 25 beats per minute in a 2/4 time)
<b>Balance:</b>	Parallel balance (30 sec), externally rotated balance (30 sec)
<b>Intensify:</b>	Added pulses to each exercise.

## CHAPTER III

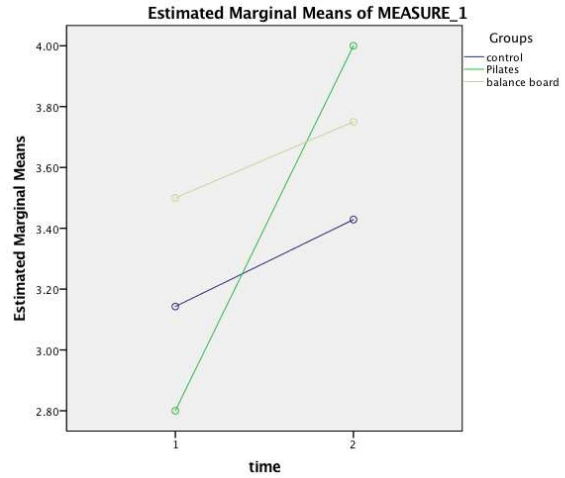
### RESULTS

The data from this study was analyzed with IBM SPSS software using ANOVA 3-way analysis with a p-value of  $<0.05$  being utilized for the dependent variables in each test. There was a significant difference found in overall time for all participants from the pretest to the post-test in the stork test in external rotation on the left side ( $p = 0.002$ ) as seen in graph 1 below and the stork test in parallel on the right side ( $p = 0.042$ ) as seen in graph 2 below. However, there were no differences found between the balance board group, Pilates reformer group, or the control group from the pretest to the post-test for the stork test in parallel on the right ( $p = 0.263$ ) or left side ( $p = 0.987$ ) or the stork test in external rotation on either the right ( $p = 0.772$ ) or the left side ( $p = 0.259$ ). There was also no significant difference in overall balance time in the stork test in parallel on the left side ( $p = 0.095$ ), and the stork test in external rotation on the right side ( $p = 0.724$ ). The star test also showed no significant difference between the three groups on either the right ( $p = 0.129$ ) or the left side ( $p = 0.791$ ) from the pretest to the post-test.



**Graph 1: Pre/Post Left Side External**

Graph 1. Results of stork test in external rotation on left side, comparing balance time between the pre- and post-tests.



**Graph 2: Pre/Post Right Side Parallel**

Graph 2. Results of stork test in parallel on right side, comparing balance time between the pre- and post-tests.

## CHAPTER IV

### DISCUSSION

Balance is crucial to a dancer's success in training and performance not only aesthetically or functionally but also to help prevent injuries. Determining a training method to improve balance would be beneficial to a dancer's overall achievements. In this study, participants in all three groups (balance board, Pilates reformer, and control) improved in their overall balance time in the ST in parallel on the right side and the ST in external rotation on the left side. After comparing pre and post test scores, all three groups showed improvement however, no improvement was shown between the control group or either of the intervention groups. The only variable that all participants had in common were the required technique class they took part in throughout the study. This result could imply that perhaps through ballet and/or technique classes one can improve ankle stability and balance. Further research will need to be done to inspect the overall impact that technique classes has on balance and if this is the most effective way to improve balance in collegiate level dancers.

Dance technique focuses on the use of the legs in parallel and external rotation. The ST test used in this study was performed in parallel and rotation however the SEBT test was only executed in parallel. In addition, both tests were executed on flat foot rather than on relevé. If the study was repeated, the researchers would include the SEBT in external rotation and perform both tests in parallel and relevé to imitate a more traditional dance balance. It would be useful to see how those results impact overall outcomes.

Balance board training and Pilates encompass a large variety of exercises that can be used in the training process. Perhaps greater difference in ankle stability and balance would be seen

between the intervention groups and the control if there were a variance in the training protocol. Pilates also uses various pieces of equipment including the exo-chair, the cadillac and spine corrector as well as numerous props for mat work. Perhaps the use of the cadillac in Pilates training could have a larger impact on the strength of the lower leg muscles thus increasing ankle stability and balance. Extended research is required in order to address the number of variables available with these two training methods and how that can influence a dancer's training and performance. Furthermore, statistical data was limited due to a small sample size, so it is far to question if the results would be different with a larger subject pool.

## **CHAPTER V**

### **CONCLUSION**

Although significance was seen pre and post testing in some aspects of overall balance there was no significant difference seen between the balance board, Pilates or control groups. Consequently, it can be determined that neither balance board nor Pilates reformer training has an impact on improving balance. Since overall balance improvement was seen in all three groups, dance training over a four-week period does appear to improve ankle stability and balance. Additional testing is warranted to determine if dance training is the most effective way to increase balance in dancers.



## REFERENCES

- Ahearn, E. (2006). The Pilates Method and Ballet Technique: Applications in the Dance Studio. *Journal of Dance Education*, 6, 92-99.
- Amorim, T., Sousa, F., Machado, L., & Santos, J. (2011). Effects of Pilates training on muscular strength and balance in ballet dancers. *Journal of Sport Sciences*, 11 (2), 147-150.
- Bernardo, L., & Nagle, E. F. (2006). Does Pilates Training Benefit Dancers? An Appraisal of Pilates Research Literature. *Journal of Dance Medicine & Science*, 10, 46-50.
- Davlin, C. D. (2004). Dynamic Balance in High Level Athletes'. *Perceptual and Motor Skills*, 1171-1176.
- Oliver, G. D., & Brezzo, R. (2009). Functional Balance Training in Collegiate Women Athletes. *Journal of Strength and Conditioning Research*, 23 (7), 2124-2129.
- Olmsted, L. C., Carcia, C. R., Hertel, J., & Shultz, S. J. (2002, December). Efficacy of the Star Excursion Balance Tests in Detecting Reach Deficits in Subjects with Chronic Ankle Instability. *Journal of Athletic Training*, 37(4), 501-506. Retrieved from PUBMed.
- SUNDARAGANESH K., MOHANDAS K., KIRUBAKARAN K. G., & VIKRAM M. (2015). Effect of Wobble Board Balance Training Program among Athletes with Functionally Unstable Ankle Joint. *Medicine & Health (Universiti Kebangsaan Malaysia)*, 10(1), 17–22. Retrieved from <http://ezproxy.library.tamu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=asn&AN=117754994&site=ehost-live>
- Verhagen, E., der Beek, A. van, Twisk, J., Bouter, L., Bahr, R., & Mechelen, W. van. (2004). The Effect of a Proprioceptive Balance Board Training Program for the Prevention of Ankle Sprains: A Prospective Controlled Trial. *The American Journal of Sports Medicine*, 32(6), 1385–1393. <https://doi.org/10.1177/0363546503262177>