Lower Body Strength-Training Versus Proprioceptive Exercises on Vertical Jump Capacity: A Feasibility Study

Charles Son, BS,[a] Adam Stewart, BS,[a] John Ward, DC, MA, MS,[b] and Kimary Farrar, DC[c]

Abstract

Objective: The purpose of this study was to test the feasibility of completing a study comparing the impact of lower body strength training to proprioceptive exercises on vertical jump capacity.

Methods: Thirty-nine college students (age 27.9 ± 6.4 y, height 1.69 ± 0.10 m, body mass 73.4 ± 15.9 kg: mean ± standard deviation) underwent baseline and post-testing of their vertical jump capacity using a Vertical Challenger and VICON motion analysis system. Participants were randomly assigned to 3 interventional groups between testing sessions: (1) lower body strength training, (2) lower body proprioceptive training, and (3) a no training control. Group 1 underwent supervised exercises 3 days a week at 2 sets of 12 repetitions of squats, seated knee extensions, standing knee flexions, and standing calf raises at approximately 25% of their body weight. Group 2 participants engaged in 4 supervised proprioceptive exercise stations 3 days a week involving BOSU ball stance, Rocker board, Bodyblade, and 1-legged stance exercises at 4 minutes per station. A between–within repeated-measures analysis of variance using between-participants factor "group" and within-participants factor "time" (baseline and post-test) was used to analyze data.

Results: Analysis of group × time indicated a small positive improvement in overall group performance for jump height at post-test, $F(2,36) = 5.527$, $P = .008$, $r = 0.36$. However, post hoc testing identified no statistically significant difference between groups for dependent variables.

Conclusions: This study determined that it was feasible to complete a study to compare 2 groups, but more than 1 week would be required to observe differences between lower body weight training and lower body proprioceptive training on vertical jump. (J Chiropr Med 2017;xx:1-9)

Key Indexing Terms: *Exercise; Athletic Performance; Proprioception; Postural Balance*

Introduction

The ability to jump is critical to performance in many sports,[1] particularly basketball, football, and volleyball.[2] Jumping ability is often tested as an assessment of lower limb strength and power.[3] A common method of testing jumping ability is through the use of jump and reach tests, like vertical jump tests.[4] Maximal force,[5] the rate of force development,[5] and muscle stiffness[6] are all important factors in vertical jump performance.

Strength training is critical for many sports[7] and has been reported to improve vertical jump height.[8] This form of training involves lifting heavy weights while completing a small number of repetitions. One area that has not been adequately studied is how proprioceptive exercises affect vertical jump performance.

There is developing research that purports that proprioceptive training lowers athlete injury risk. One consequence of training and competing in athletics is the increased risk of injury.[9] This can have a negative consequence for the player, coach, and team overall.[10] Optimal training methods to improve performance while limiting injury risk as much as possible are critical.

Proprioceptive training represents activities that help individuals gain a better conscious awareness of their body and limbs in space.[11,12] It combines static and dynamic aspects[13,14] to include passive motion sense, active motion sense, limb position sense, and sense of heaviness, which provide feedback to the neuromuscular system. This feedback is performed by stimulating muscle spindles, Golgi tendon organs, and various joint afferents (Pacinian corpuscles, Ruffini endings, and free nerve endings).[15,16] Having injured and noninjured participants engage in proprioceptive training

[a] Texas Chiropractic College, Pasadena, Texas.
[b] Department of Foundational Sciences, Texas Chiropractic College, Pasadena, Texas.
[c] Department of Clinical Reasonings, Texas Chiropractic College, Pasadena, Texas.
Corresponding author: John Ward, DC, MA, MS, 5912 Spencer Highway, Pasadena, TX 77505. Tel.: 1-281-998-5704. (e-mail: *jward@txchiro.edu*).
Paper submitted September 26, 2017; accepted October 25, 2017.
1556-3707

https://doi.org/10.1016/j.jcm.2017.10.007

results in improved coordination for both groups.[17] Preliminary studies on adding proprioceptive exercises to training programs suggest they can reduce future injury risk by providing greater joint awareness.[18-21] The optimal way to engage in balance training to improve performance is not clear, but multiweek programs are most likely to result in improvements in function.[22] The effects of proprioceptive training on vertical jump ability have been minimally researched. This is concerning considering that in the 2014 review article by Aman et al[11] they described that "there is converging evidence that proprioceptive training can yield meaningful improvements in somatosensory and sensorimotor function."

The purpose of this study was to test the feasibility of completing a study comparing the impact of lower body strength training to proprioceptive exercises on vertical jump capacity. Feasibility of recruiting capabilities, data collection procedures, and observation of preliminary data trends were assessed.[23] The physiologic parameters measured were short-term differences in vertical jump capacity after 1 week of lower body strength training compared with 1 week of lower body proprioceptive exercises.

Methods

This study was reviewed and approved by the Texas Chiropractic College Institutional Review Board for human participants in accordance with the Declaration of Helsinki. This trial was registered with the University Hospital Medical Information Network Clinical Trials Registry (UMIN-CTR), trial number UMIN 000021192 (Reg# R00024438).

Study Design and Setting

The focus of this feasibility study was to compare the short-term impact of 1 week of lower body strength training to 1 week of lower body proprioceptive training on vertical jump capacity with the intent to engage in a longer multiweek study later (Figs 1 and 2). Participants engaged in baseline and post-testing of their vertical jump capacity using a Vertical Challenger (Tandem Sport, Louisville, Kentucky) combined with a VICON motion analysis system (VICON, Centennial, Colorado). During the study, participants were randomly assigned to the following groups: group 1 engaged in 1 week of lower body strength training, group 2 engaged in 1 week of lower body focused proprioceptive training, and group 3 was a no-training control that only engaged in pre- and post-testing.

Participant Recruitment and Preparation

Student volunteers were recruited via word of mouth from our college November 2015 through January 2016. Study applicants contacted the primary investigator for screening to determine if they met the inclusion and exclusion criteria. Inclusion criteria were college student 18 to 50 years of age, capable of bending knees and jumping, and fit enough to lift weights and engage in balance training. Exclusion criteria were muscle pathologic conditions (eg, myasthenia gravis, muscular dystrophy), balance-related pathologic conditions (eg, Meniere disease, orthostatic hypotension), joint-related pathologic conditions, using an assistive device (eg, cane, walker), limb surgeries, body mass index >30 kg/m^2, or pregnancy. They were notified in advance of the study inclusion and exclusion criteria and were provided with a copy of the informed consent.

Institutional Review Board–approved informed consent was provided and signed by all study applicants before participating in this study. Table 1 lists the attributes of the 3 study groups at baseline. This feasibility study used a convenience sample and did not follow an a priori power analysis. For data collection, men wore only black form-fitting shorts and black tennis shoes. Women wore black form-fitting shorts, a nonreflective sports bra, and black tennis shoes. Standardized attire was provided by the research laboratory and was used to reduce the likelihood of any reflective clothing interfering with the VICON camera recordings and to keep footwear standardized (eg, no sandals or minimalist shoes). Participants wore their own fitness attire for the week-long exercise sessions.

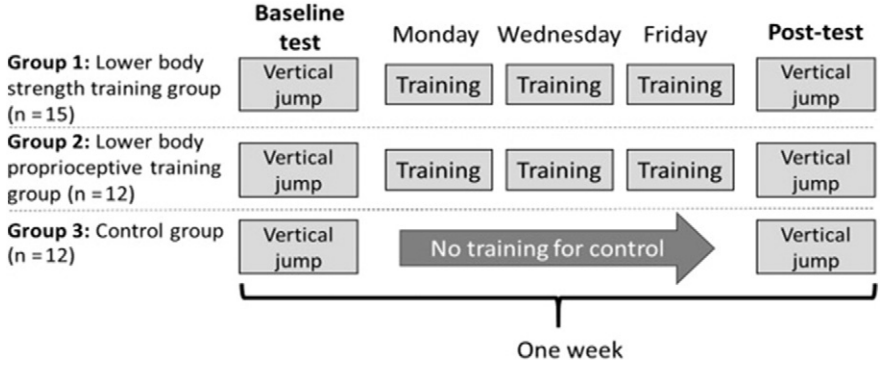

Fig 1. *Study design. The number of participants is marked in parentheses next to each group.*