THE EFFECTS OF SUSPENDED WEIGHT RESISTANCE TRAINING ON AGILITY IN COLLEGIATE ATHLETES

Bryan Christensen[1], Sam Thielen[2], Kyle Hackney[1], Jeremiah Moen[3]

North Dakota State University, Fargo, North Dakota, USA[1]
Sanford Power Center, Fargo, ND, USA[2]
Mayville State University, Mayville, North Dakota, USA[3]

Instability resistance training techniques are commonly used to increase athletic performance. The purpose of this study was to analyze the effects of performing the squat exercise with suspended weight within a six-week resistance training program on agility in collegiate male athletes. Thirty-two male collegiate baseball players were randomly assigned to a suspended or conventional resistance training group. They completed the T-test agility test before and after a six-week resistance training program. The suspended group had weight plates hanging below the barbell for the squat exercise. A repeated measures ANOVA was used to assess improvements in performance within groups and between groups. The T-test agility times for both groups significantly decreased from pre- to post-testing, but there were no significant differences between groups.

KEY WORDS: T-test, squats, baseball players

INTRODUCTION: Success in athletics requires a broad range of physical skills. Athletes use a variety of training techniques to enhance skills such as agility. Postural balance is another skill that influences athletic performance. Successful athletic performance greatly depends on the body's ability to maintain upright posture during forward, backward, and lateral movements (Yaggie & Campbell, 2006). Maintaining an upright posture can be achieved through the strengthening and improved coordination of the core stabilizing muscles. Research has shown that a strong core creates a firm foundation for limb movement (Anderson & Behm, 2005; Behm & Anderson, 2006; Behm, Drinkwater, Willardson, & Cowley, 2010; Bliss & Teeple, 2005; Huxel Bliven & Anderson, 2013; Willardson, 2007). Studies have linked greater muscle activation in the core to unstable exercises that require greater body stabilization (Campbell, Kutz, Morgan, Fullenkamp, & Ballenger, 2014; Schwanbeck, Chilibeck, & Binsted, 2009). Training under unstable conditions challenges the neuromuscular system in a way that replicates the demands faced while performing many sports tasks (Behm et al., 2010; Kibele & Behm, 2009; Willardson, 2007).
There is limited research using suspended training loads rather than conventional loading on a barbell. Suspended loads may relate better to athletics because the source of instability is in the load rather than the contact point between the feet and the ground. One study found suspended weight to elicit greater muscle activation in the core musculature while creating only minor decreases in force production (Lawrence & Carlson, 2015). No studies were found that examined suspended load exercises and the effect on T-test or agility in general. In a related five-week study, Tomljanovc, Spasic, Gabrilo, Uljevic, and Foretic (2011) found significant improvement in the hexagon agility test in both functional and traditional training groups but no differences between groups. They also found no significant improvements in either group in the 5-10-5 meter agility test. Another related study examined the effects of a nine-week hip rotation strength training program on agility (Nelson & DeBesliso, 2014). They found no significant differences in the T-test and the hexagon test between a group that completed the hip rotation training and a group that did not. The purpose of the present study was to analyze the effects of performing the squat exercise with suspended weight within a six-week resistance training program on agility in collegiate male athletes.

METHODS: A repeated measures randomized experimental design was used to assess differences in performance adaptations as a result of training with conventional or suspended loading in the squat exercise. Thirty-two male collegiate baseball players from Mayville State

University (MSU) with resistance training experience participated in identical six-week off-season resistance training programs. They were randomly assigned to either conventional or suspended loading conditions during the squat exercise. All other exercises in the program were performed with conventional loading.

During the week prior to beginning the six-week resistance training program, the height, weight, age, year in school, and resistance training experience (years) of all subjects was measured and recorded. Pre-testing was completed four days prior to starting the training program. On the day of testing, subjects completed a five-minute dynamic warm-up, followed by a T-test to obtain a measure of agility. The dynamic warm-up included 12 exercises such as high knees, side lunges, and skips for distance.

After pre-testing was completed, subjects were sorted based on their training years, and randomly assigned to either the conventional (16 subjects) or suspended group (16 subjects). For the duration of the resistance training program, the suspended group performed the squat exercise using Stump Straps (Spud, Inc., Columbia, South Carolina, USA) to suspend all of the weight plates from the barbell. The conventional group performed the squat exercise with traditional loading of weight plates on the barbell.

The resistance training program used in this study was the current MSU Baseball off-season training program. Each resistance training session consisted of approximately 15-minutes of the same dynamic warm-up that was completed prior to the pre-test along with mobility exercises (such as arm circles and good mornings), 15-minutes of assorted agility training drills (such as double leg forward line hops and single leg lateral line hops), 45-60 minutes of resistance training (Table 1), and 15-minutes of flexibility training.

Table 1. Sample Resistance Training Program

Exercises	Sets	Reps
Upper-body day		
Dumbbell	4	6
Pullups	3	Max
Push-up combo	3	5 clap + 15
Barbell row	3	8
Dips	3	8
Single arm dumbbell row	3	10
Lower-body day		
Squat	4	4
Sumo deadlift	4	6
Single leg squat	3	6
RDL	3	6
Side lunge	2	15
3-way shoulder raise	3	10

Subjects were again tested on the T-test three or four days after completion of the six-week program using the same procedures as the pre-test. Data collected from the pre- and post-tests were used to analyze any difference in improvement within groups and between the conventional and suspended groups using a repeated-measures analyses of variance (ANOVA). The level of statistical significance was set to $p<0.05$.

RESULTS: The mean for the conventional training group was 10.01 ± 0.35 seconds for the pre-test and 9.91 ± 0.45 seconds for the post-test. The suspended load groups' results were 9.78 ± 0.44 seconds and 9.66 ± 0.47 seconds for the pre-test and post-test respectively. Both groups experienced a significant ($F=4.755$, $p=0.037$) decrease in time for T-test performance from the pre-test to the post-test. However, the differences in the decrease in times were not significantly different between groups ($F=0.024$, $p=0.878$).

DISCUSSION: Both training groups were effective in decreasing times in the T-test. The suspended group reduced their T-test time by 1.23%, while the conventional group showed a mean reduction of 1.0%. Although statistically insignificant, the 0.23% greater improvement made by the suspended-load group may warrant further investigation assessing the influence of suspended load training on agility measures.

Our results agree with Tomljanovc, et al. (2011), who found significant improvement in the hexagon agility test in both functional and traditional training groups but no differences between groups. Their results did not agree with ours for the 5-10-5 meter agility test. Our results did not agree with results of a study by Nelson and DeBesliso (2014), who found no significant differences in the T-test and the hexagon test between a group that completed the hip rotation training and a group that did not.

There were a few limitations in the study. One was that the suspended load was only applied to one exercise within the training program. MSU Baseball's off-season training program included speed/agility training and multiple other lower- and upper-body exercises which may have diluted the affect of the suspended-load group. Implementation of an unstable load is not possible in all exercises, but a greater effect may have been observed if more suspended loaded exercises were included within the experimental training program. Future research should compare two training programs consisting entirely of either suspended load and conventionally loaded free weight exercises. It is also possible that six weeks was not long enough to develop significant differences between groups of trained college athletes irrespective of the mechanism of loading.

CONCLUSION: A suspended and conventional resistance training program were found to significantly decrease T-test agility times during a six-week off-season resistance training program in collegiate baseball players. However, no differences were found between training groups. Further research needs to be done examining differences between these groups with more suspended-load exercises included.

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Acknowledgement: The researchers thank the Mayville State University baseball team for participating in this research study and the coaches for allowing us to use their athletes.