



Purpose

- Do resisted sprint drills and power runs on an adjustable, self propelled treadmill elicit short distance speed, agility and vertical gains?

Subjects

- Soccer Athletes
- N=47
- Means:
 - Age 14.4 ± 1.7 yrs
 - Height 65.8 ± 5.1 in
 - Weight 119 ± 29 lbs

Measures

- Vertical Jump (SVJ)
- 10 yd sprint-9.1 m (SAS10)
- 20 yd sprint-18.2 m (SAS20)
- Pro Agility Test (COD)
- Woodway Max Velocity (MV)

Design

- Technique instruction on rhythm and form.
- 6 weeks of **resisted sprint** drills 2x per week.
- 8 weeks of **max speed sprints** at a % of their max load
- **Drills with load** (Phase 1-2)
 - A-Marches
 - A-Skips
 - Form Runs (w/ leg cycle)
 - 3-4-3
- **Power Sprints** (Phase 3-4)
 - Phase 3 @ 30,35,40%
 - Phase 4 @ 20,15,10%

Results

- Improvements:
 - **SAS10:**
 - Pre: 1.87
 - Post: 1.80
 - **SAS20:**
 - Pre: 3.24
 - Post: 3.14
 - **SVJ:**
 - Pre: 19.4
 - Post: 21.0
 - **COD:**
 - Pre: 4.88
 - Post: 4.67
 - **MV:**
 - Pre: 9.5
 - Post: 10.4

The Effects Resisted Sprint Training on Speed, Agility and Power Production in Young Athletes:

****Scott Moody**

Introduction

According to Eston *et al.* (1) "...attempts have been made to measure maximal velocity and power output during maximal short-term running on a non-motorized treadmill ... in untrained and trained children." The treadmill was able to measure mechanical power using a belt attachment and was deemed "...promising for the measurement of running muscle power." This study was conceived under the assumption that the Eston manual was accurate.

Methods

Experimental Approach

Pilot work found that subjects who had previously spent months/years training rhythm and sprint speed technique were able to accelerate the rate of speed and power improvement by changing only the way they did their sprint drill and rhythm warm up. We designed this study to monitor more closely, the effects of 2 x per week sprint drill training protocols on a resisted Woodway Force© treadmills.

Subjects

47 eighth and ninth grade soccer players, with previous training experience participated in this study. Their ages ranged from 13.1 to 14.8, their height ranged from 60 to 68 inches, and their weight ranged from 82 to 148 pounds. They have all had previous experience (3 months or more), in some type of strength, speed and agility program. The strength and speed ranges of the athletes varied tremendously as would be expected in this type of study, but the training protocols were kept similar throughout the course of this study.

Each athlete was very efficient in every exercise and testing measure. Due to previous experience both in training and testing the athletes were efficient squatters, jumpers and their speed and agility technique was above average for their age. These factors eliminate the "learning curve" response that most test subjects see over their first phase of training. These are kids that understood the mechanics of running but were not yet efficient in those mechanics. These kids have spent the time to establish a very good foundation of strength and conditioning, but their results had started to plateau at the time of the study.

Testing and Measurement

Vertical Jump (SVJ):

The vertical jump test was used due to its widely accepted intra-subject reliability and the fact that it does not require high motor ability and can easily be performed by children. After a 45 minute warm up consisting of dynamic flexibility, stability, and balance and agility based movements, each subject was given 4 attempts in a jump and reach (counter movement jump - with no step) using a Vertek © device. The best jump was recorded.

Woodway© Max Velocity (MV):

Using the Woodway© Force© Treadmill each subject was instructed to run at top speed with a Load of 0 for 5-8 seconds. They repeated this 4 times after a 15 min dynamic flexibility warm up and a rhythm and sprint drill technique session. Full recovery was suggested and left up to the individual to assess. Each subject took approximately 45 seconds of recovery between runs.

10 and 20 Yd Sprint (SAS10 and SAS20):

Using a Newtest Powertimer© photocell system with a link to a palm monitor we timed each subject in a 10yd sprint using a switch to start and a photocell at the 10yd mark and 20yd mark to time them. The timers are accurate to .001 s. Each subject was timed 3 times with a 60-90 s rest



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in between runs, after a 15 min dynamic flexibility warm up and a rhythm and sprint drill technique session.

Pro Agility Test (COD):

Using a Newtest Powertimer© photocell system with a link to a palm monitor we timed each subject in a 20 yd Pro Agility Test (20 yd Shuttle or 5-10-5 test) using a switch to start and a photocell at the finish line. The timers are accurate to .001 s. Each subject was timed 3 times with a 60-90 s rest in between runs, after a 15 min dynamic flexibility warm up and a rhythm and sprint drill technique session.

Testing Procedure:

Each subject was tested in each of these areas on the first week of the Winter Training Session (11-14-05 to 2-24-06) with a focus on educating them proper technique, and strategy to ensure a good test. We let each subject take 2 to 4 attempts at each test to try and achieve their best. Each subject had previous experience in these testing procedures and we have

Training Programs

Phase I and II:

The training program was broken into 6, 15 minute blocks (1-Warm Up, 2-Sprint Drills / Rhythm Drills / Stability Drills, 3- Athletic Movement/Low Level Plyos/Speed/Agility, 4-Power Production, 5-Strength Training, and finally 6-Conditioning and Core Work).

- **Warm up:** primarily composed of some basic reciprocal inhibition (muscle activation) and dynamic flexibility work
- **Sprint drills/Rhythm/Stability:** (see below)*
- **Plyo/speed/agility:** rapid and short response (basic) plyometric drills, rhythm and coordination footwork, single-cut lateral agility drills, and sprint drill work on the Woodway Force treadmill.
- **Power:** basic hip extension (pull based) lifting with light weight for reps of 4-8 at 30-70% of 1RM
- **Strength:** basic upper and lower body exercises (squat, lunge, incline bench or push up, modified pull up (inverted row), light db combos and complexes)
- **Conditioning and Core Work:** medicine ball core circuits combined with 75% of max speed technical runs to get the heart rate up over a 10 min period (see below)

*During the 2nd 15 minute block (2-Sprint Drills/Rhythm/Stability) the group performed sprint drills, combined with balance and hip and hamstring based stability drills (lateral sport cord walks and physioball hamstring curls. They performed the sprint drills, skipping drills and form runs on the Woodway Force © Treadmill. Here is the Format:

- 3-20 yd A-Marches (at 50 load, 40 load, and 30 load **for athletes under 110 lbs we went 40 load, 30 load and 20 load)
- 3-30 yd A-Skips (at 30 load, 20 load, and 10 load ** for athletes under 110 lbs we went 20 load, 10 load and 0 load)
- 3-30 yd form runs (at 10 load **for athletes under 110 lbs we went 0 load on the runs)

The groups also performed a **3-4-3 run** at the end of the workout. Here is the format:

- 3-10 second 75% sprints with a 10 second rest between each, then rest for 50 seconds
- 4-10 second 75% sprints with a 10 second rest between each, then rest for 50 seconds
- 3-10 second 75% sprints with a 10 second rest between each

Phase III and IV:

After the initial 6 week block with a 2 week break for the holidays (where training attendance was irregular) we shifted into a power/speed phase to finish off the winter periodization. The training program was broken into 6, 15 minute blocks (1-Warm Up, 2-Sprint Drills / Rhythm Drills / Stability Drills, 3- Athletic Movement/Low Level Plyos/Speed/Agility, 4-Power Production, 5-Strength Training, and finally 6-Conditioning and Core Work).

- **Warm up:** primarily composed of some basic reciprocal inhibition (muscle activation) and dynamic flexibility work
- **Sprint drills/Rhythm/Stability:** (see below)**



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- **Plyo/speed/agility:** rapid and short response (basic) plyometric drills, rhythm and coordination footwork, single-cut lateral agility drills, and power run work on the Woodway Force treadmill.
- **Power:** basic hip extension (pull based and jump squat based) lifting for reps of 4-6 at 60-80% of 1RM in pulls and 30-40% of 1RM in jump squats) during phase III, and then in phase IV we lightened up to 4-6 reps at 50-70% of 1RM in the pulls and 20-30% in the jump squats.
- **Strength:** implemented circuits going off of the athletes maxes so as not to attempt to get stronger, but rather move the weight more efficiently. Band squats, explosive step up exercises, and plyo type push ups were added to the strength protocol.
- **Conditioning and Core Work:** medicine ball core circuits combined with interval runs to get the heart rate up over a 10 min period (see below)

**In Phase III we supplemented the sprint drills with power runs at percentages of their max load (the maximum load that they could keep the belt moving a steady pace). For the 3 weeks of Phase III the loads were set at loads between 30 and 50 (week 1), 40 and 60 (week 2) and 50 and 70 (week 3) based on the weight of the athlete. These max sprints were taking place in the 2nd block of the workout (taking the place of the sprint drills) and the athletes would perform 4 sprints at the predetermined load with 2 minutes of recovery between sprints.

In Phase IV we shifted to a unloading (speed) phase where the loads for the power sprints were set at 20% (week 4), 15% (week 5), and 10% (week 6) of each athlete's *newly determined* "max load" (the maximum load that they could use and still keep the belt moving continuously). The format for the power sprints was the same as Phase III.

Results

The following graphs will show at a glance what took place in each phase of training. In Figure 1 Figure 2 and Figure 3 you see the most interesting correlation of the study. As strength increases in the first 2 phases so does vertical and max speed on the Woodway Force, but in phase 3 when we shifted to power runs and heavier "power" type loads in the weight room, vertical has it's largest increase, while max speed on the Woodway drops off. Thus **giving the impression that vertical and speed are stimulated by two completely different types of training**. This was reinforced in phase IV when the loads in the weight room and on the Woodway Force were decreased to elicit more speed. In phase IV, verticals dropped and max speed had its largest increase of the quarter. Similar improvements were also noticed in 10 and 20 times as well as 20 yd shuttle times.



Figure 1: shows max speed at 0 load on the Woodway Force treadmill during each of the phases during the winter quarter 2006.

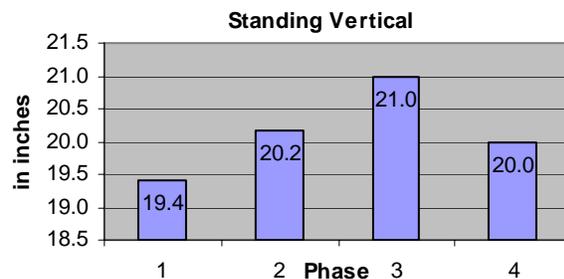


Figure 2: Standing verticals tested by phase during the winter quarter 2006 using a Vertec machine.



Figure 3: Shows strength gains by phase during the winter quarter 2006. Squat maxes were done as front squats or with dumbbells and Bench maxes were done as incline or a modified lift with dumbbells for our younger athletes.

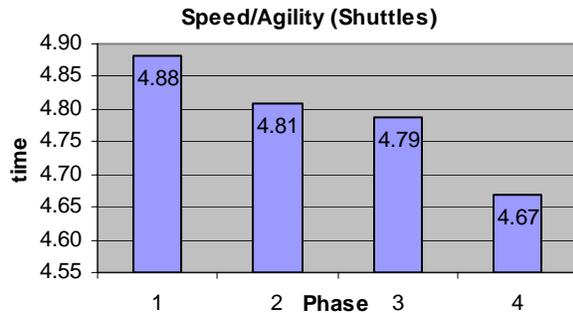


Figure 4: shows improvements in 20 yd shuttle tests during the phases during the winter quarter 2006.

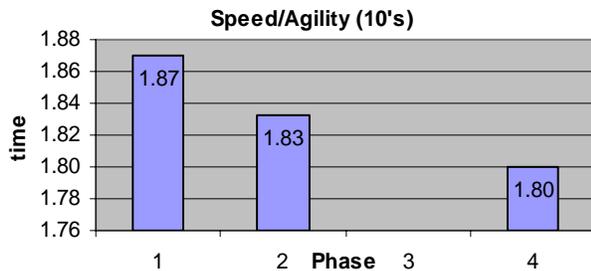


Figure 5: shows average 10 yd dash (electronically timed) during the phases during the winter quarter 2006.

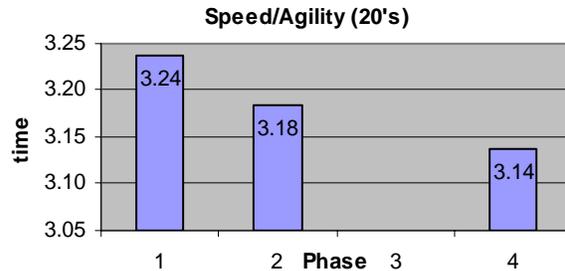


Figure 6: shows average 20 yd dash (electronically timed) during each of the phases during the winter quarter 2006.

Discussion

The primary aim of this study was to look at the effects of speed training on a resisted treadmill device, and see if the new stimulus could elicit increases in speed, agility and vertical power in trained athletes that were starting to plateau. Although there were some issues related to the quality, and control of the study, this type of approach serves more of a real world application than a sterile research environment.

Overall, the study was successful. By introducing a new stimulus in the form of a resisted running machine like the Woodway Force Treadmill, trained athletes will significantly improve their acceleration power and top end speed performance, even when no other sprint type movement training is being trained.

Vertical performances dropping off in the final phase could be linked to the decreased emphasis on strength, just as the vertical increases in the first three phases could be linked to increases in strength.

The significant increase in shuttle performance could be linked to some of the footwork and technical applications we implemented with this group. However, there is no doubt in my mind that the athletes that took part in this training got more explosive coming out of the changes of direction, as well as accelerating after the change.

Issues with predetermined load

There were, however, several theories on how to improve the collection of data, and how to keep future studies on the Force Treadmill more sterile. One such theory is that the specific load that is used on the Woodway Force treadmill may be responsible for much of the improvement and lack



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thereof in some of the lighter, shorter athletes. We noticed that with some of the lighter, shorter and less aggressive athletes were not improving along the same curve as some of the other taller, stronger, and more aggressive athletes. This caused us to look a little closer at the prescribed load on the Force as well as the comparison of 10 and 20 times to the max Force velocity. The load was selected based on pilot studies done with 185-200 pound males. We very quickly found out that the prescribed load issue may be negatively affecting this study.

Issues with weight

Some of the heavier athletes were running at high speeds on the Force Treadmill but not necessarily the in the 10's and 20's. Conversely we had some smaller, lighter athletes running slower speeds on the Force Treadmill but running fast 10 and 20 times. Even though the load on the Force Treadmill is set at 0 there is still between 16 and 18 lbs of load on the belt according to a Woodway representative. This would mean that some of our 85 lb young soccer players would be running at 21% of their body weight even when the load is at 0, as compared to a 200 lb athlete running at only 9% of their body weight at 0 load.

Issues with height

Height also played a role in the max speed you would be able to generate on the Force Treadmill. The taller athletes, by leaning forward were able to use that increase in leverage or momentum to put themselves into a better position to accelerate the treadmill's belt.

Issues with consistency between machines

One final theory was noticed by accident when some of our athletes found that they could move faster on 1 Force Treadmill than they could on another. Although the speed is accurate, if one belt is looser than another it is going to move faster. There needs to be some type of calibration for each treadmill to ensure accurate collection of data. To control this, the athletes were required to run on the same treadmill throughout the entire study so that improvements would be accurate.

Practical Applications

This study provides a basis for our program to build other studies around improving speed and power performances on a resisted running machine such as the Woodway Force Treadmill. The phase I and II protocol set up for our athletes seemed to be a great foundation and did help the athlete understand the mechanics of sprinting.

It is far easier to teach mechanics on a resisted treadmill where the athlete can experience perfect posture and body lean with out falling forward. This gives the instructor or coach time to teach the athletes about positioning while the athlete is strengthening the movements associated with the maintenance of those positions. I think, however that the load used in the marches and skips needs to directly reflect the height, weight and strength of the athlete. In this study we prescribed loads based solely on weight, and in doing this we noticed that some athletes were improving along different curves. We have made this change and will have the new research out in the summer of 06.

During the phase III and IV parts of the program the power runs seemed to have a negative effect on the athletes max speed on the Force Treadmill. This could be related to the time it takes the body to adapt to the increases in load. However, I feel that the loads were most likely to high for the majority of our athletes. We have since made the modification to take the max load that they are able to keep the belt moving consistently, and then prescribe percentage loads off of that.

We tried this with another group over the last phase of this study and we found that the when more accurate percentages were used, the athlete's speed was more closely related to how they performed in the 10 and 20 yd sprints. Therefore I feel that their loads should be determined by defining a max and prescribing percentages, just like in the weight room. We will have new protocols out in the summer 2006.

References

1. Eston, Roger and Reilly, Thomas. *Kiianthropometry and Exercise Physiology Laboratory Manual – Tests, Procedures and Data – Second Edition Volume 1* Routledge (UK), 2001.