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The Effectiveness of Combining Vibration and High Speed Treadmill Training within an 8-week Speed and Power Program for High School Athletes

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Abstract

Since the mid 1980's, high speed treadmills have been steadily gaining popularity as a tool for increasing running speed for speed and power sports (i.e. football, soccer, basketball, etc.). It has been used in a variety of settings with mixed results. Vibration training has also gained a great deal of popularity with this population. Vibration has been an effective tool for increasing power output because of the neurological activation that takes place during weight bearing activities on a vibration platform. This study looked at integrating the technology of vibration with high speed treadmill methods into an established strength and conditioning program. A group of 21 high school athletes (16 male and 5 female) between the 9th and 12th grade (mean = 10.5) participated in an 8 week offseason strength and conditioning program which consisted of linear speed, minor lateral speed and agility, strength training, and the EXSPEED™ PRO treadmill program. Athletes were grouped into the control (PRO) and experimental group (PROVIBE) which integrated vibration training. Mean improvements for the PRO group were 0.15s in 40 yd dash, 1.08in. in the Vertical Jump, and 0.07s in the 20 yard Shuttle Test. Mean improvements for the PROVIBE group were 0.27s in the 40 yd dash, 0.55in. in the Vertical Jump, and 0.18s in the 20 yd Shuttle Test. The study showed that both programs were highly effective for speed and agility training, but the PROVIBE group showed itself to be a more effective means of increasing speed and quickness.

Background

Since the mid 1980's, high speed treadmills have been steadily gaining popularity as a tool for increasing running speed for speed and power sports (i.e. football, soccer, basketball, etc.). It has been used in a variety of settings with mixed results. Oftentimes, it has used has as the sole means of speed training in small private settings where the technology is the main driver for training, rather than focusing on the integrating the technology as a tool in the athlete's overall strength and conditioning program.

If we break speed down into its various segments, there has been a multitude of research to support the use of the high speed treadmill as an effective speed training modality. Increased stride length is a product of power development and speed strength (1). Research has shown that running uphill on a treadmill will increase the muscle activity of the quads, glutes, and posterior muscles of the calf (13, 18, 22, 24). These are the muscles primarily responsible for power development and movement of the body (6). This increase of up to 75% in propulsive forces takes place with no impact, making it not only an effective tool, but a very safe training method (9).

Stride frequency is improved by forcing the leg to get through the leg cycle at a faster rate (4), typically performed with overspeed training. Decreasing the time spent in the flight phase of running will dramatically improve stride frequency. Caldwell and Swanson proved that running at high speeds at elevation force the body to spend and increased amount of time in the stance phase of running, thus decreasing recovery time (25). This is especially true when spotting the athlete at speeds which are higher than they are accustom to running. It is understood that overspeed training is largely a neuromuscular response. Thus, initial improvements are rather temporary, but once the movement is performed repeatedly for 2-5 weeks, more permanent muscular changes will take place (10, 15).

Other positive effects of treadmill running include improved mechanics (17) and a great deal of metabolic improvements in anaerobic conditioning (11, 14, 19, 20).

Over the past 10-15 years, vibration training has become a very popular method of training for athletes of all ages and levels. It has been implicated in methods to improve everything from oxygen uptake, to bone density in post

menopausal women, to improved flexibility in rehabilitation settings. One area that a lot of research has been focused on is in increased acute power output following bouts of whole body vibration. Most of the research has concluded that whole body vibration can cause an acute increase in power which is appropriate for speed and power athletes (2, 21, 27). This is likely due the increase in neurological activation and activity within the musculotendinous junction that exists in skeletal muscle (21). Research shows that the training effect is rapid and occurs with weight bearing exercises on a vibration platform (2, 27)

Methods

A group of 21 high school athletes (16 male and 5 female) in grades 9-12 (mean 10.5) participated in an 8 week offseason strength and conditioning program. The program consisted of linear speed, lateral speed and agility, and strength training.

Athletes were tested upon initiating the 8 week program in the 40 yard dash, Vertical Jump, and 20 yard Shuttle. Sprint times were collected using a Speed Trap® electronic timing system and the Vertical Jump was performed on a Vertec® measuring system. Both systems were properly calibrated and checked for accuracy prior to testing.

Linear speed training was performed two days per week with one workout performed in a traditional setting with traditional ground based methods. The second workout each week was performed on a high speed treadmill (Woodway Desmo; 0-18.0 mph; 0-25% elevation) utilizing the **EXSPEED™ PRO** treadmill workouts by Maximum Training Solutions, LLC. **EXSPEED™ PRO** is a treadmill training system which prescribes semi-customized workouts for multiple athletes for speed and power development. These workouts consist of multiple runs of varying speeds (3.0-18.0 mph) and elevations (0-25%) during each workout.

The subjects were divided into two separate groups for their treadmill training sessions. Group ***PRO*** (n=10) trained using the **EXSPEED™ PRO** system of treadmill training. The second group (***PRO*VIBE**) (n=11) used a version of the **EXSPEED™ PRO** system which incorporated Vibration (Vibraflex 550) to aid in motor unit recruitment, recovery, and power development in each workout. Each group consisted of athletes who had trained with the **EXSPEED™ PRO** system prior to the research and several athletes that were new to high speed treadmill training. Specific volumes and intensities were prescribed for each athlete during the initial evaluation upon entering the **EXSPEED™ PRO** system. The coaches performing the treadmill workouts were trained on proper implementation of the **EXSPEED™ PRO** system. Proper spotting was performed by the trained coach to ensure quality overspeed training and guarantee safety.

The ground based workouts where prescribed by the coach on site and consisted of traditional speed training programming, including acceleration drills, sprints of varying distances (10-60yds), and towing drills. The ground based speed workout also included some drills to improve lateral speed and agility. Both speed training workouts included a dynamic warmup and sprint mechanics drills (i.e. A skips, High Knees, Butt Kicks, Leg Cycles, etc.).

Strength training workouts were performed 3 days per week. They consisted of High Intensity Training (HIT) for the total body. These workouts consisted of 2 sets, each performed to failure, on 8-12 exercises.

At the end of the 8 week training session, all of the athletes were re-tested on the same parameters as in their initial test (10 yard dash, 40 yard dash, Vertical Jump) to assess their progress.

Results

Mean scores for the initial test were as follows:

- Experienced **EXSPEED™ PRO** subjects: 40 yard dash=4.92s (range=4.50s-5.60s); Vertical Jump=24.85in. (range=18in.-30in.), and 20 yard shuttle=4.66s (range=4.35s-5.1s)
- New **EXSPEED™** subjects: 40 yard dash=5.40s (range=4.82s-5.86s); Vertical Jump=21.07in. (range=15.25in.-26in.), and 20 yard shuttle=4.98s (range=4.41s-5.50s)

Mean Improvements during the training were as follows:

- **PRO** Group: 40 yard dash=0.11s (range=0.46s-(-)0.11s); Vertical Jump=1.10in. (range=2.00in.-(-).50in.), and 20 yard shuttle=0.04s (range=0.37s-(-)0.25s)
- **PROVIBE** Group: 40 yard dash=0.20s (range=0.61s-0.01s); Vertical Jump=0.75in. (range=1.50in.-(-).50in.), and 20 yard shuttle=0.11s (range=0.47s-(-)0.04s)

Mean Improvements for New athletes during the training were as follows:

- **PRO** Group: 40 yard dash=0.15s (range=0.46s-0.03s); Vertical Jump=1.08in. (range=2.00in.-0.00in.), and 20 yard shuttle=0.07s (range=0.37s-(-)0.16s)
- **PROVIBE** Group: 40 yard dash=0.27s (range=0.61s-0.15s); Vertical Jump=0.55in. (range=1.50in.-(-)1.00in.), and 20 yard shuttle=0.18s (range=0.47s-(-)0.04s)

Discussion

While high speed treadmill training has been widely accepted to be an effective means of speed training, it has historically been performed on a treadmill with much larger capabilities (0-40% elevation and 0-30 mph) than used here. The current study looked at the effectiveness of a treadmill training system which was performed on a treadmill with much smaller capabilities (0-25% elevation and 0-18 mph). In addition to the uniqueness of the treadmill, the addition of vibration training also makes this a very exceptional project.

The current study showed improvements across virtually every area of training that we examined. Both the **PRO** and **PROVIBE** groups saw significant improvements in the area of speed, power, and agility. When we first looked at the pretest, one thing jumped out before the training even started. The success of the **EXSPEED™ PRO** program is evident when you compare the pretest results of the athletes who have participated in the program prior to the start of the training. Athletes with **PRO** experience ran almost 0.4sec faster in the 40-yard dash, almost 4 inches higher in the Vertical Jump test, and over 0.3sec faster in the 20 yard shuttle test. So, when we look at the posttest results, they will be compared to an impressive program. It definitely speaks to the success of the program, but it also made it necessary to compare the total groups to each other, but it is necessary to look at the results for both experienced and new athletes individually.

When we look at the posttest numbers for both the **PRO** and **PROVIBE** groups as a whole, we find that both groups made very nice improvements. The **PROVIBE** group improved by almost twice as much (0.11sec. vs. 0.20sec.). We saw similar large improvements in the 20 yard shuttle test. This is likely due to the increased neurological efficiency within the athlete's body. This is proven by the fact that we did see a good improvement in the agility score with very little training for lateral speed and agility. Surprisingly, though, we did not see a large improvement in Vertical Jump in the **PROVIBE** group.

To further the analysis of the results, we turn our attention to just the new athletes who have not participated in a high speed treadmill training program prior to their training. This allows us to get slightly more predictable results because we can compare athletes who have a similar training history. Athletes who have trained in the **EXSPEED™ PRO** program previously will have more difficulty seeing large improvements than new athletes due to the trainability of the nervous system.

The group of new athletes who trained in the **PROVIBE** group improved tremendously by achieving an impressive 0.27 second improvement on average in the 40 yard dash. This was compared to the results of 0.15 second improvement for the **PRO** group. The results for the **PRO** group are consistent with previous results for the **EXSPEED™ PRO** training system. Large improvements were also seen in both groups for the shuttle test, but once again, we see a much better improvement for the athletes who trained in the **PROVIBE** group. The Vertical Jump results are consistent with the larger groups in that both groups showed an improvement, but we didn't see as big of an improvement with the **PROVIBE** group as we expected.

The theory of neurological activation seems to have held up with the athletes who participated in the vibration group. The nervous system controls every motion that an athlete's body makes, so it only makes sense that training this system will improve athletic performance. Overall, it appears that the vibration component of the **PROVIBE** program has taken a good speed training product and made it better.

Conclusion

The **EXSPEED™ PRO** high speed treadmill training program when performed on a Woodway treadmill with elevations up to 25% is an effective tool for speed training when properly integrated into a successful strength and conditioning program. This study also showed that the integration of vibration training with the **EXSPEED™ PRO** training modality makes for a superior training method for high school athletes who compete in speed and power sports.

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