ACUTE EFFECTS OF THE SPEEDMAKER RESISTIVE SPRINT DEVICE: ELECTROMYOGRAPHY AND KINEMATICS

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The SpeedMaker resistive sprint device is claimed to elicit post-activation potentiation, improve knee height and upper leg drive to improve sprint performance. There was a total of 9 participants in the present study. The participants were tested on two days for changes in knee and hip angles, sprint times and changes in muscular activation. The present study found no presence of post-activation potentiation no evidence of changes improved knee height or upper leg drive from the SpeedMaker device. The purpose of the current study was to assess the claims that the SpeedMaker device improves sprint performance. The present study tested 10 female track and field and lacrosse athletes on the effects of this device. The findings of the present study is that the SpeedMaker device may decrease knee angle.

KEY WORDS: post-activation potentiation, sprint time, joint angles

INTRODUCTION: Sprint performance has been considered a large component of sport performance and for this reason different training protocols and resistive devices have been developed to attempt to enhance sprint performance. The SpeedMaker resistive device is a new product made by Elite Athlete Products incorporated and its manufacturer claims it can improve sprint performance (The Science Behind the Product, 2016). Knee drive height or hip angle have been considered critical kinematic parameters for sprint performance (Mann & Herman, 1985), which may be why it is important that the SpeedMaker device was developed to improve that aspect of sprinting. The SpeedMaker device adds resistance to the hip with resistance bands, which may cause a great enough stimulus during the conditioning contraction to elicit post-activation potentiation. Post-activation potentiation is considered the increase in ballistic abilities after a conditioning contraction (Evetovich, Conley, & McCawley, 2015). Post activation potentiation has been shown to increase muscular activity (Gullich & Schmidtbleicher, 1996) (Hodgson, Docherty, & Robbins, 2005) and if the SpeedMaker device is a great enough stimulus it will increase the muscular activity of the gluteus maximus. The purpose of the current study is to give evidence to whether these claims are elicited and cause an effect on acute sprint performance, as this is the first scientific assessment of this product.

METHODS: Nine female Track and Field and Lacrosse athletes participated in the current study and signed an informed consent before participation. The participants were volunteers and allowed to drop out at any time. The current study took place on two days separated by a minimum of 24 hours and maximum of 96 hours. The experimental and control days began with a self-selected warm up consisting of sprints, plyometric and dynamic stretching for five minutes without the device. On the experimental day, the participants wore the SpeedMaker device for three 50m sprints, at 80, 90 and 100% of maximal sprint speed, that were meant to be the conditioning contractions for post-activation potentiation, with each sprint separated by a one minute rest. The SpeedMaker device is a harness device that straps on over the shoulders, around the abdomen and lower thigh, with resistance bands running across the anterior portion of the hip. On the control day the participants forgo the conditioning contraction. After two minutes rest, the participants did the jumping and sprinting protocols separated by two minutes per attempt. The jumping protocol is the primary focus of another study and will not be spoken of any farther in the current study. The participants will be equipped with BTS FREEMG 300 electrodes (BTS Bioengineering; Garbagnate Milanese MI, Italy) for electromyography and reflective markers for kinematics. The electrodes were

placed halfway between the crease of the hip and the anterior portion of the patella for the rectus femoris, halfway between the base of the gluteus maximus and crease of the knee for the biceps femoris and on the gluteus maximus halfway between the base of the gluteus maximus and attachment on the ilium. The participant's had their skin abraded with fine sand paper or gauze pads, wiped with alcohol and the electrodes were placed. The reflective markers were placed on the participant's knee and hip joints and on the mid shank on the left lateral side, as in the same place as consistently as possible between days. The participants were assessed for sprint time at 10, 20, 36.58 (40 yards) and 50 meters with Microgate (Bolzana BZ, Italy) timing gates.
Range of motion was calculated using the minimum and maximum angles of each joint assessed. Muscular activity was assessed for duration of activation, mean integrated electromyography signal and percent of maximal voluntary contraction. Kinematics were measured using 7 motion analysis cameras at 60 Hz, digitized and Butterworth filtered at 6Hz (LeBlanc & Gervais, 2004) using the Cortex Motion Analysis software (Santa Rosa, CA). Analysis of the electromyography measurements were full wave rectified, band pass filtered at 10 to 450 Hz and integrated using the BTS analysis software. Statistical analysis for the current study was done with a paired t-test for kinematics and sprint time. A paired t-test and a 2-way repeated measures ANOVA were used to analyze electromyography. Effect size was analyzed with a Cohens D analysis ($t/\sqrt{n}$) (Cohen, 1988). Effect size references were: small=0.2, Moderate=0.5, and larger=0.8.

RESULTS AND DISCUSSION: The present study found no evidence that post-activation potentiation was present, demonstrated by the lack of increases in muscular activation in the muscles studied and lack of improved sprint times (all presented in table 1). There was in fact a non-significant but visually present decrease in activation of the extensor muscles of the hip and knee (gluteus maximus and biceps femoris). The change in extensor activation was coupled with a tendency to increase activation of the flexor muscle (recuts femoris), as demonstrated in figure 1.

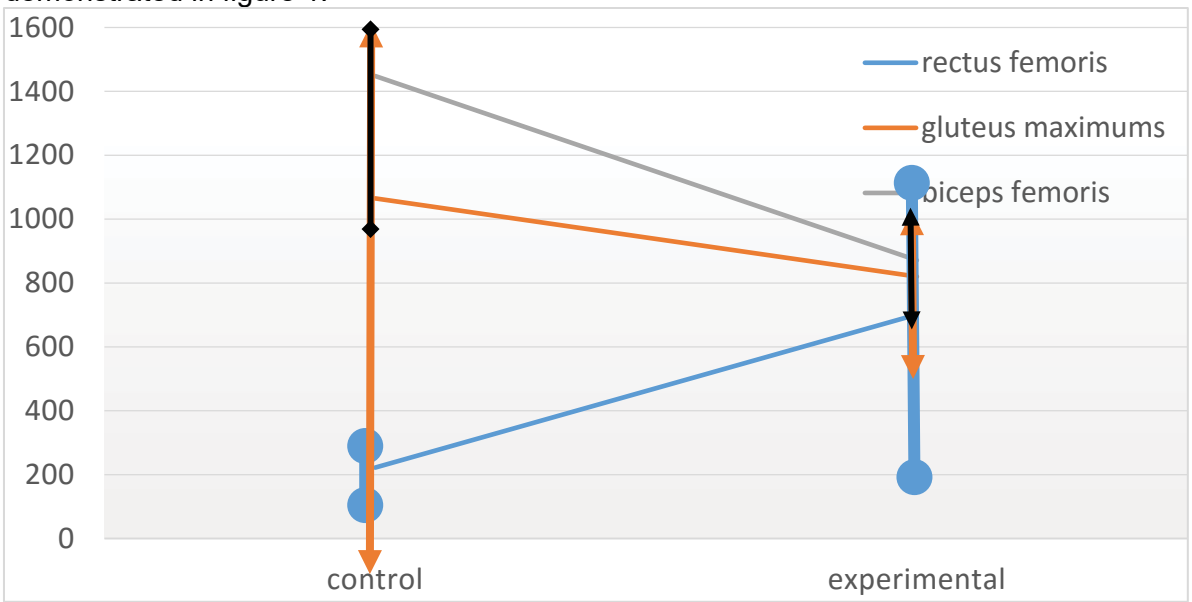

Figure 1: Graphic of the interaction (arrows represent ± STD) of the muscles between the control and experimental trails.

There was a near significant ($p<0.087$) change in the averaged activation of the rectus femoris. The lack of significance and large standard deviation in muscular activity may be a product of individual differences or high and low responders that are common issues in post-activation potentiation research ((Tillin & Bishop, 2009) (Comyns, Harrison, Hennessy, & Jensen, 2007)). Individual differences in post-activation potentiation are affect by factors such as: muscular strength and fiber type (Aagaard, 2003), training age (Chiu, et al., 2003), and power to strength ratios (Tillin & Bishop, 2009).

Table 1
This table displays all of the electromyographic measurements in the current study.

	Control	Experimental	Probability	Effect size
Rectus femoris activation average (mv) (n=9)	0.063 ± 0.095	0.123 ± 0.082	0.087	-0.651
Biceps femoris activation average (mv) (n=9)	0.086 ± 0.027	0.087 ± 0.024	0.923	-0.033
Gluteus maximus activation average (mv) (n=8)	0.092 ± 0.131	0.042 ± 0.011	0.296	0.400
Rectus femoris %MVIC (n=9)	222.162 ± 154.506	701.649 ± 837.875	0.140	-0.546
Biceps femoris %MVIC (n=8)	1065.075 ± 901.480	819.962 ± 312.667	0.523	-0.238
Gluteus maximus %MVIC (n=8)	1447.803 ± 2408.264	837.304 ± 584.664	0.496	0.254
Rectus femoris active duration (n=9)	0.170 ± 0.091	0.162 ± 0.136	00.897	0.0443
Biceps femoris active duration (n=9)	0.320 ± 0.321	0.277 ± 0.069	0.710	-0.129
Gluteus maximus active duration (n=8)	0.166 ± 0.069	0.181 ± 0.083	0.502	-0.250

Table 2
This table displays all of the kinematic and sprint time measurements.

	Control (n=7)	Experimental (n=7)	Probability	Effect size
Knee extension	19.159 ± 5.592	20.745 ± 5.735	0.645	-0.183
Knee flexion	126.59 ± 6.054	121.22 ± 9.976	0.137	0.649
Knee range of motion	107.355 ± 9.389	100.511 ± 9.216	0.006	1.586
Hip extension	-14.108 ± 3.070	-14.738 ± 3.014	0.66	0.175
Hip Flexion	34.146 ± 3.456	32.145 ± 3.988	0.341	0.390
Hip Range of motion	48.244 ± 5.308	46.883 ± 5.065	0.638	0.187
10m sprint	2.111 ± 0.133	2.114 ± 0.326	0.976	-0.121
20m sprint	3.624 ± 0.176	3.668 ± 0.344	0.606	-0.206
36.58m Sprint	6.22 ± 0.661	6.059 ± 0.518	0.433	0.318
50m sprint	7.992 ± 0.383	7.993 ± 0.815	0.997	-0.002

The results of the present study, for the most part, agree with LeBlanc and Gervaise (2004) that showed no changes in kinematics of sprinting from the use of resistive sprint devices. However, there was a significant ($p>0.006$) change in the present study in the range of

motion of the knee, which decreased in the experimental trails compared to the control trials. The range of motion change agreed with Cronin and colleagues (2008), as they found significant changes in knee angles from resistive sprinting devices. The interaction of the extensor and flexor muscle of the hip was not significant but the visible tendency could be a product of fatigue as that has been considered a detrimental factor in many post-activation potentiation studies (Tillin & Bishop, 2009). The majority of the findings from the present study had moderate to low effect sizes, as measured by a Cohen's D analysis. The variables and their effect sizes are displayed above in table 1 and 2. The only large effect sizes were found in the knee range of motion. The present results show there is a greater chance that the changes in range of motion of the knee may happen in the same fashion with a larger sample size. The present study has the limitation of an overall lack of power from a small sample size and a possibility of individual variability (Comyns, Harrison, Hennessy, & Jensen, 2007).

CONCLUSION: The present study does not support the claim that post-activation potentiation will be present from the use of the device, as there were no significant increases in electromyographic measurements and no significant improvements in sprint time. The present study could demonstrate that the SpeedMaker resistive sprint device could affect knee angles but there was no evidence that it could affect hip angles. Future research on this product could benefit from greater sample sizes, greater rest times as there may have been an effect of fatigue on the presence of post-activation potentiation (Tillin & Bishop, 2009) and a large enough sample size to assess for individual variability.

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Acknowledgements

This research was funded in part by a Northern Michigan University Progressive Research and Innovative Mutual Exploration (PRIME) Fund grant and Elite Athletic Products. The authors of the study would also like to thank the Northern Michigan University Track and Field and Lacrosse teams for their cooperation in the current study.