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Acute Effects of The Stick on Strength, Power, and Flexibility

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ABSTRACT

The Stick is a muscle massage device used by athletes, particularly track athletes, to improve performance. The purpose of this project was to assess the acute effects of The Stick on muscle strength, power, and flexibility. Thirty collegiate athletes consented to participate in a 4-week, double-blind study, which consisted of 4 testing sessions (1 familiarization and 3 data collection) scheduled 1 week apart. During each testing session subjects performed 4 measures in the following sequence: hamstring flexibility, vertical jump, flying-start 20-yard dash, and isokinetic knee extension at $90^{\circ}\cdot s^{-1}$. Two minutes of randomly assigned intervention treatment (visualization [control], mock insensible electrical stimulation [placebo], or massage using The Stick [experimental]) was performed immediately prior to each performance measure. Statistical analyses involved single-factor repeated measures analysis of variance (ANOVA) with Fisher's Least Significant Difference post-hoc test. None of the variables measured showed an acute improvement ($p \leq 0.05$) immediately following treatment with The Stick.

Key Words: massage, ergogenic aid, isokinetic, vertical jump, speed

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Introduction

Ergogenic aids are substances or devices designed to improve human performance in sport and other activities (9). Today more than ever, athletes and the public are barraged with radio and print media advertisements and infomercials touting the benefits of ergogenic aids. Unfortunately for the consumer, most of the claims made by manufacturers or marketing agencies about their products are untested, unproven, and in some instances downright false. The sale of ergogenic aids is a multibillion dollar industry and products are appearing on the market at an ever-increasing rate (9). Although it is impossible to test all of these products, there are a few that merit research as to their efficacy. One such product is a device known as The Stick (Relaxicizor Products Inc., Atlanta, Georgia), which has been featured in lay publications such as *Runner's World* and *Running Times,* as well as a professional journal, *The Journal of Myofascial Therapy* (2).

The Stick (Figure 1) is a nonmotorized device used by athletes to massage their muscles. It is a 24-inch long, semirigid rod around which independent, 1-inch spindles rotate. It is designed to assist persons in the deep manipulation of soft tissues, particularly muscle. It is being used by athletes, particularly track athletes, to enhance performance. The manufacturer claims that using the device prior to activity will break up trigger points in the muscle and improve blood flow, which in turn will improve flexibility, muscular strength, and power. Although the precise mechanisms of how The Stick works are not clear, proponents of The Stick are convinced that it is effective. To date, no peer-reviewed reports have been published either supporting or refuting the efficacy of this product. Therefore the purpose of our study was to objectively assess the acute effects of The Stick on muscular strength, power, and flexibility in a group of collegiate athletes.

Methods

An a priori 1-way sample size determination test (Sigma Stat, SPSS Inc., Chicago, IL) with power set at 0.8 and a significance level of $p \leq 0.10$ revealed that 30 subjects would be needed. Subjects for this study were male and female National Collegiate Athletic Association Division II soccer ($n = 7$ men), basketball ($n = 13$ women), and volleyball ($n = 10$ women) athletes. All subjects read and gave informed consent. Each of the sports represented requires athletes to possess not only good endurance but also perform power movements such as jumping or sprinting. The athletes were told that we were comparing 3 different ways of pre-

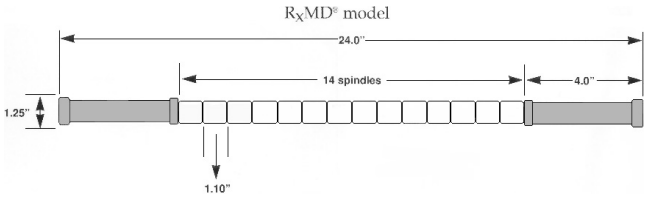

Figure 1. Illustration of The Stick.

paring for competition. At no time were they ever told that we were testing a particular product. The athletes were tested on 4 separate testing days, each at least 7 days apart. In addition, particular attention was paid to scheduling each athlete at the same time of day for each session. The first testing day served as a familiarization session. On the remaining 3 testing days each subject performed a standardized warm-up on a Schwinn Airdyne by performing 5 minutes of leg and arm cycling at level 3 (approximately 150 W) on the workload indicator. They were then assessed for flexibility, muscular power (both vertical and horizontal), and muscular strength in the order listed using the following performance tests: hamstring flexibility, vertical jump, flying-start 20-yard dash, and isokinetic concentric knee extension. Immediately prior to each performance test, subjects received 2 minutes of pretest intervention. The 3 pretest interventions used were as follows: control (visualization), placebo (mock insensible electric stimulation), and experimental (The Stick). The 3 pretest interventions were randomly assigned to each of the 3 testing days for each subject. In other words, only 1 pretest intervention was used for each test day and the order of assignment was random for each subject.

Finally, the study used a double-blind design. The athletes were blind as to which treatment was being tested by being informed that 3 different modes of sports preparation were being used to see which was the most effective. In addition, the pretest interventions were performed out of the view of the test administrators such that they were blinded as to which pretest intervention had been performed by the athlete. Special codes were used on the data sheets to prevent any possibility of test administrators determining which interventions had been used. Only after the 4-week study was completed did the test administrators become privy to information about the pretest interventions.

Testing Protocols

Muscular Flexibility. Flexibility was measured using a Leighton flexometer (6). Hamstring flexibility was measured with the subject supine on a training table. The flexometer was placed on the lateral aspect of the right thigh just proximal to the knee. Subjects were asked to slowly flex at the hip while keeping the ankle dorsiflexed and knee extended. The range of hip flexion was measured to the nearest degree. Subjects performed 3 trials, and the average of the 3 trials was used to represent hamstring flexibility.

Muscular Power. Muscular power was assessed in both the vertical (vertical jump) and horizontal (flying-start 20-yard dash) planes of movement. The vertical jump was used to assess vertical power (1). The vertical jump height was assessed using a Vertec jump apparatus (Sports Imports, Columbus, OH). Subjects performed a no-step (i.e., standing), countermovement jump with arm movement allowed. Each subject was asked to perform 3 maximal jumps with the highest jump being used to represent their vertical jump height. Vertical jump height was measured to the nearest 0.5 inch. The flying-start 20-yard dash was used to indicate horizontal power. The athletes performed the sprint on an indoor track to ensure constant environmental conditions and were timed using photoelectric timing cells (Brower Speedtrap II, Brower Timing Systems, Draper, UT). In order to minimize any error due to poor starts, the 20-yard sprint time was performed with a flying start. In other words, subjects actually sprinted 30 yards, but only the time for the last 20 yards was recorded. Each subject performed the sprint twice with approximately 2 minutes rest between trials. The fastest time was used to represent their 20-yard sprint time. Sprint times were measured to 1/100th of a second. It should be noted that although time (seconds) is not a unit of measure for power, it is still a direct indicator of horizontal power if body weight and distance are held constant when using the following formula: power ($N \cdot m \cdot s^{-1}$) = body weight (N) $\times$ velocity ($m \cdot s^{-1}$).

Muscular Strength. Concentric muscular strength was assessed using a KINCOM III (Chattecx Corporation, Hixson, TN) isokinetic dynamometer set at a movement speed of $90° \cdot s^{-1}$ (4). The range of motion (0° being full knee extension) was from a start position of 80° of knee flexion to 10° of knee flexion. Machine setup measurements for each athlete were recorded during the first familiarization session and used to ensure consistent setup on subsequent testing days. In each testing session, subjects were instructed as to the purpose of the test and given a warm-up. The warm-up consisted of 5 submaximal contractions progressing in contraction intensity from approximately 50 to 100% effort. Subjects were then asked to perform 3–5 maximal knee extension movements. The curve demonstrating the greatest peak force was used to represent the subject's maximal strength.

Pretest Intervention Protocols

The order of pretest intervention for each athlete was randomly determined. Only 1 of the pretest interventions was used for each testing session. Once it was determined which pretest intervention was to be used for that day, the athlete performed 2 minutes of the

intervention immediately before each performance test. In other words, 2 minutes of intervention followed by test 1, then back for another 2 minutes of intervention, then test 2, and so on. During the control intervention, subjects were supine on a padded training table and were asked to visualize for 2 minutes the test they were about to perform. During the placebo intervention, subjects were supine on a padded training table and were asked to concentrate on the test they were about to perform. In addition, small surface electrodes that were connected to a mock (i.e., no electrical current) electrical stimulation unit were placed on both ankles. Subjects were told that a small insensible electric current would be passed through them for 2 minutes. For the experimental intervention, subjects were asked to concentrate on the test they were about to perform while they administered self-massage using The Stick. Prior to the hamstring flexibility test, the hamstrings were massaged. For the vertical jump and the 20-yard sprint, the gluteals, hamstrings, quadriceps, and calf muscles were massaged. Finally, for the isokinetic leg extension strength test the quadriceps were massaged. Subjects administered the self-massage for a total of 2 minutes prior to each test.

Statistical Analyses

Data analysis included computation of descriptive statistics of subject demographics (mean ± *SD*) and all other variables (mean ± *SEM*). Statistical investigation into the potential differential effects of the control, placebo, and experimental interventions on the various performance tests was performed using a 1-way repeated measures analysis of variance (ANOVA). Significant interactions were analyzed using the Fisher LSD method for pair-wise multiple comparisons.

The original study design set the significance level at $p \leq 0.10$. We did this for several reasons. First, our subjects were trained athletes and the differences in performance, if any, after the pretreatments were expected to be small. In order to detect small differences at the more rigorous $p \leq 0.05$ level, the number of subjects (i.e., athletes) required would have been over 100. Finally, using a significance level of $p \leq 0.10$ would decrease the chance of a type II error, for which there is an increased risk when working with highly trained athletes (5). However, it should be noted that for publication purposes the more rigorous $p \leq 0.05$ was used as the basis for our final conclusions.

Results

Subject demographics are shown in Table 1. The effect of the 3 pretest interventions are shown in Table 2. None of the performance measures were significantly affected by acute pretreatment with The Stick ($p < 0.05$). It should be noted that there was a trend toward improvement in the 20-yard dash ($p = 0.08$) after pretreatment with The Stick. In fact, if the less rigorous $p < 0.1$ level was used as originally designed, this finding would have been significant.

Table 1. Subject demographics (mean ± *SD*).

Sport	*n* (30)	Age (years)	Height (cm)	Weight (kg)
Soccer	7	19.5 ± 1.2	180.6 ± 6.1	74.9 ± 6.1
Volleyball	10	18.8 ± 1.2	173.7 ± 2.8	66.2 ± 6.4
Basketball	13	19.1 ± 0.8	176.8 ± 5.6	71.6 ± 6.3
Average		19.1 ± 1.1	176.5 ± 5.6	70.6 ± 7.0

Table 2. Effects of the 3 pretest interventions on each of the performance tests (mean ± *SEM*).

Pretest intervention	Hamstring flexibility (degrees)	Vertical jump (in)	Flying-start 20-yard dash (sec)	Knee extension strength (*N*)
Control	92 ± 2.0	20.0 ± 0.5	2.76 ± 0.03	687.5 ± 20.2
Placebo	90 ± 2.0	19.7 ± 0.4	2.76 ± 0.03	681.7 ± 20.9
The Stick	93 ± 2.0	20.2 ± 0.6	2.74 ± 0.03	689.8 ± 22.0

Discussion

The Stick is an ergogenic aid that increasingly is being used by athletes to massage muscle and other soft tissues. Manufacturer claims are that as little as 30 seconds of massage with The Stick can improve flexibility, strength, and power. This study was designed to objectively assess the acute effects of The Stick using one of the populations to which it has been marketed, namely athletes. Several strong points of the study are the number of athletes tested; the double-blind, placebo-controlled experimental design; and the randomization of pretesting interventions for each subject. Shortcomings of the study were that we only tested the acute effects (i.e., effects of a single application) of The Stick and the running speed was measured over only 20 yards. However, we felt that the study design would detect any significant improvements if in fact they existed.

Measures of hamstring flexibility, vertical jump height, muscular strength, and speed were not significantly affected after pretreatment with The Stick (see Table 2). Hamstring flexibility varied by no greater than 3° between any of the pretreatment interventions. Likewise, vertical jump height varied less than one-half inch and peak isokinetic muscular strength changed less than 8.8 N (i.e., 2 lb). Interestingly, the performance time of the 20-yard dash after pretreatment with The Stick decreased by 0.02 seconds over the other pretreatments. Although this improvement seems small, it is important to remember that this was

over only a 20-yard distance. If an athlete were able to reduce his or her time by 0.02 seconds over each 20-yard segment, in a 100-yard sprint the cumulative effect would be a 0.1-second improvement. In sprints where the difference between first and third is measured in hundredths of a second, this improvement is certainly noteworthy.

It is possible that the trend toward improved performance in the 20-yard dash was the result of a placebo effect or was just an aberration in the data. However, the experimental design and protocols used lessen the likelihood that this was the case. First the athletes did not really know which of the interventions was the true experimental intervention. At the beginning of the study athletes were told that we were comparing 3 different ways of preparing for competition to see which one was best. At no time were they ever told that we were testing a particular product. However, just in case an athlete had seen the product advertised in a magazine and might be biased about it, the experimental design included a placebo control. Therefore the possibility of a placebo effect was further minimized. When asked at the end of the study, most of the athletes thought the mock electrical stimulation intervention was the one that would improve performance.

In addition, the order of the pretest interventions were randomized for each subject, and the test administrators did not have any knowledge of which pretest intervention was used. The 20-yard distance was marked off prior to the beginning of the study, and the same marks were used throughout the duration of the project. Plumb bobs were used to ensure that the photocells were accurately aligned for each day of testing, and finally the 20-yard dash was timed electronically. Taken in combination, these practices negated the possibility of measurement or tester bias for any one particular intervention. As such we feel that the improved sprint speed that occurred after pretreatment with The Stick is real and not a chance occurrence.

Finally, we employed the recommendations of Hopkins et al. (5) to further examine whether the 0.02-second decrease in the 20-yard dash time after treatment with The Stick would be practically meaningful to the coach and/or athlete. To do so, we calculated the coefficient of variation for performance of the 20-yard dash and compared it with the 95% confidence limits of the observed change (i.e., 0.02 seconds). The coefficient of variation is the intra-athlete variability (i.e., *SD*) in performance of a task expressed as a percentage of the athlete's mean performance in that task (5). We used the 20-yard dash times from the placebo and control interventions for each athlete to establish the intra-athlete (i.e., within athlete) *SD* in performance of the 20-yard sprint. The mean intra-athlete *SD* in 20-yard dash time was $\pm$ 0.03 seconds, which yielded a coefficient of variation of 1.1% (0.03/2.76 seconds). When the upper limit of the 95% confidence limits (2.9%) for the 0.02-second improvement was compared with the calculated 1.0% coefficient of variability, it is obvious that the likely range of improvement is well outside the normal intra-athlete variability of performance in the 20-yard dash. This indicates that there is a chance to see an observable improvement in performance due to pretreatment with The Stick.

The underlying theory as to what might explain the trend toward an improvement in sprint performance is beyond the scope of this study. However, there are several published physiologic effects caused by massage (8), although not using The Stick, that may explain our observation. One possibility is that massage with The Stick immediately prior to the sprint broke up what are known as ''barrier trigger points'' (3). Barrier trigger points are identified by Bonci and Oswald (3) as inflexible bands of muscle containing knots resulting from muscle spasm. These barrier trigger points are typically painless and can result in muscle weakness, isolated muscle fatigue, stiffness, and thus poor timing or rhythm during activity (7). All of these could obviously have an impact on sprinting. Massage with The Stick, similar to that of manual massage, may break up these trigger points. Decreasing muscle spasms would not only decrease the amount of internal resistance to muscle movement but also enable the previously spasmodic tissue to contribute to the activity being performed.

Why the other measures of physical performance did not show trends toward improvement is puzzling. It may be that the measures of flexibility and strength are rather 1-dimensional when compared with the complexity and coordination required to sprint. As such, large improvements in the simpler tasks are not as remarkable while the combined effects in more complex tasks become more evident. The vertical jump, although a coordinated task, is so brief in duration at least in comparison to the sprint that any combined improvements in the various parameters are not given a chance to be revealed.

In conclusion, no statistically significant changes were noted on the various performance measures after acute pretreatment with The Stick. However, there was a trend toward improvement in the 20-yard dash time. Although the 0.02-second decrease in time was small and not statistically significant, it was enough to have practical implications in a sport where hundredths of a second mean the difference between winning and losing. Whether this speed improvement is real and not artifact or whether the improvement holds up over longer distances is an arguable and certainly interesting possibility. Further testing of The Stick or other massage methods is warranted, particularly in regard to effects of their chronic use during training and con-

ditioning, rather than just acute effects. Examining the potential of such devices on recovery after exercise is also a very intriguing area. Relatively little research along these lines has been done. In many respects gaining further insight into methods for enhancing recovery and their impact on performance may be as important as further research into the specific effects of exercise training itself.

Practical Applications

There were no statistically significant ($p < 0.05$) improvements in hamstring flexibility, vertical jump, concentric isokinetic quadriceps strength, or the 20-yard dash speed after acute pretreatment with The Stick. However, our results do suggest that self-massage of the quadriceps, gluteal, hamstring, and calf muscles using The Stick immediately prior to sprinting may have a positive, although not statistically significant, impact on sprint performance. Whether the improvement in sprint speed is real and/or whether it holds up over distances greater than 20 yards is a subject for further research.

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