Dynamic Stretching Program augmented by self-Myofascial Release on Knee Flexion

Passive Motion and Sprint Speed

**Context:** Stretching techniques as well as self-myofascial release (self-MFR) have recently been integrated into prevention and rehabilitation approaches when working with athletes.

**Objective:** To investigate the effectiveness of accepted stretching and self-MFR techniques on knee passive range of motion (PROM) and sprinting performance.

**Design:** Randomized Controlled Clinical Trial.

**Setting:** Alvernia University Physical Education Center.

**Participants:** Fifteen healthy out of season athletes from women's field hockey, women's soccer, and men's soccer.

**Intervention(s): (Independent Variables)**

Two groups performed a dynamic stretch program protocol and one experimental group also performed a self-MFR technique using a foam roller over the quadriceps muscle bilaterally.

**Main Outcome Measure(s): (Dependent Variables)**

Knee PROM was measured using standardized clinical goniometry. The Speedtrap 1 Brower Timing System™ was used to measure sprint speed over 40-meters.

**Results:** A tendency towards significant difference in knee flexion PROM after DSP and DSP/self-MFR program was seen. A tendency towards significance (.090) was seen in both treatment groups showing increased PROM. Pretest and posttest sprint times in the DSP only group showed a slight, but not significant, decrease in sprint time. Pretest and posttest in the
DSP/self-MFR group showed a marked, yet not significant, increase in sprint times. Sprint times were significantly different (.045) when comparing the experimental groups’ posttest.

**Conclusions:** There was only a tendency towards statistical significance between knee PROM in the DSP/self-MFR group and DSP only group. However there was a significant difference between the two experimental groups.

**Key Words:** Self-MFR, DSP, Quadriceps Flexibility, OPTP Black Axis™ Foam Roller, Goniometry.

**Key Points**

- Self-MFR can alleviate pain and muscle spasm resulting in increased tissue extensibility.
- It is proposed that if the quadriceps is more flexible, sprint speed will increase.
- Comparison of each of the three groups: DSP with no MFR vs. DSP with MFR to a control group.

There have been many methods employed to prevent athletic injuries as well as to improve athletic performance. Stretching techniques as well as self-MFR have recently been integrated into prevention and rehabilitation programs when working with athletes. There is evidence in the literature that a dynamic stretching program (DSP) is more beneficial than static stretching. In addition, self-MFR has become increasingly popular among the athletic training profession due to the preliminary positive benefits on joint range of motion (ROM) and tissue extensibility as espoused by manufacturers, although there is little study of the efficacy of self-MFR. It is thought then that this increased ROM may have a positive effect on athletic performance, such as contributing to decreased sprint time.
This study was conducted to see if there is an increase in joint PROM as a measure of flexibility and if that has an effect on sprint performance, demonstrated as a decrease in sprint time with the application of a dynamic stretching program in conjunction with a self-MFR technique. A dynamic stretching program was selected because studies have proven that a static stretching program delivers no benefit with a goal of increased sprint performance. The intent of this study was to compare the effects on knee joint passive range of motion (PROM) of three stretching regimens: 1.) The control group, which did no stretching, 2.) a DSP group, and 3.) a DSP augmented by a self-MFR technique group; and second, to examine the relationship between joint PROM and sprint speed. We hypothesize first that joint ROM will show a greater increase in the DSP augmented by self-MFR group compared to the other two groups and second that this increase in joint PROM will decrease sprint time as a reflection of an increase in performance.

METHODS

Design

We used an Experimental ANOVA: Repeated measures design (mixed design) whereby each participant was assigned to three groups using a stratified randomized design where gender was used to assign within the groups: Group 1.) no stretching (control group), Group 2.) DSP group, and Group 3.) DSP/MFR group.

Participants

Fifteen (15) healthy out of season university athletes from women's field hockey, women's soccer, and men's soccer (age=18±3, gender distribution: 9 males, 6 females) participated in this study. All participants had been cleared for athletic participation at Alvernia University, according to established procedure. No participant had sustained a lower extremity
injury in the previous 2 weeks and if an injury had been sustained in the 4 weeks prior to the start of the study, the participant was first functionally tested and cleared by a certified athletic trainer before participation. Participants with a concurrent medical condition that put them at risk for an episodic event, such as asthma had informed us prior to participation. Participants with a goniometric measurement of 150° or less of passive range of motion (PROM) in knee flexion with the hip stabilized in full extension were included. Any participants who had over 150° of PROM in knee flexion were excluded. All participants were instructed about data collection procedures and the study procedures, given a visual demonstration and a written informed consent. The Alvernia University Internal Review Board approved the study and all investigators completed the certification process from the National Institutes of Health (NIH). The participants were informed of risks, as outlined in the informed consent. Participants were randomized into three groups using a stratified randomized design, following pretest baseline measurements of bilateral PROM of knee flexion and sprint time.

**Procedures**

Two of the three groups of randomly selected athletes participated in a set DSP protocol developed by Herman & Smith\(^3\), used with permission in this study. In addition, one group also performed a self-MFR technique using a foam roller over the quadriceps muscle bilaterally after the performance of the DSP.

PROM of the knee was measured bilaterally using standardized clinical goniometry, by three examiners: one student researcher to stabilize the segment, the second, an experienced certified athletic trainer as a double-blind to align the goniometer in accordance with standardized landmarks and the third, a student researcher, to record the measurement. Three measurements for each leg were averaged for a mean pretest, as well as a posttest measurement.
The Speedtrap 1 Brower Timing System™ was used to measure sprint speed. The participants were instructed to give a maximal effort and to sprint as fast as they possibly can for the duration of the 40-meters. A baseline sprint speed was determined as an average of three sprints with five minute rest intervals between sprints. Rest intervals were timed by the same individual using the same stopwatch for the duration of the study. The posttest average sprint speed was determined at the end of the study in a similar manner.

The participants received visual and verbal instruction by us on proper performance of the rolling technique. Self-MFR was performed using a 36” by 6” round OPTP Black Axis™ foam roller with firm density. Treatment time consisted of three minutes of continuous rolling of the quadriceps femoris muscle group. The target treatment area was from the musculotendinous attachment of the rectus femoris at the anterior superior aspect of the pelvis (point A) to the musculotendinous junction of the quadriceps just superior to the patella (point B). (Figure 3a) When a hot spot was located, the foam roller was to be held in place on the area for 30-90 seconds. While supporting the upper body in the prone position with both elbows on the floor, both legs were positioned in full extension and transverse the ridge of the roller during the technique. The forearms and hands of the participant laid flat on the ground parallel to the roller and were also used to propel and stabilize the participant. (Figure 3b) The athlete moved over the foam roll at a rate of approximately one inch/second. Participants performed the self-MFR technique immediately after each DSP performance. To ensure correct technique, every participant was directly observed every session for all five sessions for all four weeks by one of us.

RESULTS
A One-Way ANOVA was used to compare 1) the mean pre-test PROM and 2) the pre-test sprint speeds for the three groups. Between-subject results were insignificant for both tests, implying effective randomization of the groups prior to treatment [PROM: F(2,12)=1.345; p=0.297. Sprint: F(2,12)=0.416; p=0.669]. Results for the mean post-test PROM and Sprint were also insignificant, indicating no significant differences in PROM or Sprint following treatments [PROM: F(2,9)=1.148; p=0.360. Sprint: F(2,9)=0.134; p=0.876].

Next, a Repeated Measures Mixed Design ANOVA was used to analyze the two treatment groups for change in PROM and Sprint scores and to investigate any interactions. The pre- and post-test PROM/Sprint scores were the repeated measures, taken on the two treatment groups. For PROM, the within-subjects results showed an overall improvement from 137.09 to 140.40 which was tending toward significance [F(1,5)=5.945; p=0.059]. However, a significant PROM*Group interaction was indicated, in which the DSP/self-MFR group showed a greater improvement than the DSP group (see chart below) [F(1,5)=6.907; p=0.047]. For Sprint, the within-subjects results were insignificant, indicating no improvement [F(1,5)=2.205; p=0.198]. However, once again, a significant interaction, Sprint*Group, was discovered, in which the DSP/self-MFR group speeds increased, while those of the DSP group decreased (see chart below) [F(1,5)=7.030; p=0.045]. It should be noted that during the first week of the program, the participants in the DSP/self MFR group anecdotally reported a perceived feeling of tightness in the hamstrings, which may have contributed to the increased sprint times.

**DISCUSSION**

A thorough review of the literature was conducted to operationalize the variables under study. Meroni et al.\textsuperscript{6} compared active versus static stretching techniques and their effects on active knee ROM. The study examined sixty-five participants divided between two randomized
groups, active and static. The results inferred that the active stretching routines had a greater effect on active knee ROM than a static stretching regimen. In this experiment, we utilized, with the permission of Herman & Smith³, an accepted DSP program (appendix A) that resulted in decreased sprint times over a four week period for participants.

Myofascial release (MFR) techniques can be a useful modality for athletic trainers and physical therapists. It can be implemented to alleviate pain and muscle spasm, which is thought to subsequently improve soft tissue extensibility.⁹ Over the past decade, self-MFR has become a common technique to treat myofascial restrictions and to restore normal soft-tissue extensibility. Self-MFR is increasingly used as a method to supplement traditional methods, such as stretching, to the treatment of soft-tissue injuries². Self-MFR can be an effective form of treatment valuable to the athletic training profession.

Self-MFR is thought to increase soft-tissue extensibility through autogenic inhibition in the Golgi tendon organs (GTOs) of a muscle.²⁴⁹ GTOs sense tension and rate of tension change within the musculotendinous junction. Extended stimulation of the GTO by pressure applied from a foam roll is greater than the stimulation of only the tension impulses of that muscle causing the contraction⁴. These techniques are not hard to learn, and they are inexpensive to implement.

The quality of foam rollers range from high to low density, varying the amount of pressure exerted into the muscle. Higher pressure values exerted by a more rigid roller might allow deeper penetration into the soft tissue than that of a less rigid roller. Studies indicate that deeper penetration might aid in the overall healing process of damaged tissue and increase muscle extensibility if introduced at the appropriate time and process.² The type of foam roller used in this study will be a 36” by 6” round OPTP Black Axis™ foam roller with firm density.⁶
The muscles of the lower extremity are viewed as the largest and most powerful muscles in the body. They play an enormous role in the propulsion of the body as well as balance, managing the weight of the body against the force of gravity, and, on a more focused viewpoint, sprinting and the force required to move at a given speed. The quadriceps, a muscular group comprised of four muscles: vastus lateralis, vastus medialis oblique, vastus intermedius, and rectus femoris, is the most responsible for producing speed and appears to be the most crucial muscle in the sprinting phase.  

CONCLUSIONS

Although not significant (p=0.059), the overall increase in knee PROM was expected in both the DSP only group and the DSP/self-MFR group. We hypothesized the post-test knee PROM in the DSP/self-MFR would be significantly greater than the DSP only group, but this did not prove to be the case. However, there was a significantly greater pre- to post-test change (improvement) in PROM for the DSP/self-MFR group, as determined by the use of a Repeated Measures ANOVA. For Sprint, although there was not significant overall reduction in times, there was a significant difference in the change between the two groups: the DSP/self-MFR group saw its times increase, while the DSP group saw a decrease. The increase in sprint times seen in the DSP/self-MFR group could possibly be due to the program design of the foam rolling only the quadriceps and not the hamstrings. This design could have contributed to an undesirable muscular imbalance. Interestingly, a study by Winchester et al. demonstrated that static stretching also contributed to increased sprint time. The question is raised as to whether stretching of any kind, static or dynamic, may be inhibitory to performance. We recommend further study with larger numbers and self-MFR of both the quadriceps and hamstring groups.
References


Figure Legends

Figure 1: Goniometry measurement of knee PROM using approved anatomical landmarks.

Figure 2: Starting position for timed 40m sprint using the Speedtrap 1 Brower Timing System™.

Figure 3A-1: Self-MFR Point A where participant begins the self-rolling technique

Figure 3A-2: Self-MFR Point B where participant ends the self-rolling technique

Figure 3B: The forearms and hands of the participant lay flat on the ground parallel to the roller and are also used to propel and stabilize the participant.