INTRODUCTION

- Limited hamstring extensibility may contribute to the large number of hamstring pathologies present in athletes.
- Hamstring extensibility is modifiable through a variety of stretching protocols: static, dynamic, or proprioceptive neuromuscular facilitation (PNF).⁴
- Static and dynamic stretching have been shown to increase muscle extensibility and joint range of motion (ROM) by breaking up adhesions and/or scar tissue in the muscle tissue and fascia through pressure and friction.⁴
- Foam rolling is a type of myofascial release used to increase muscle extensibility, and is used to treat injuries and improve muscular performance.⁵
- Foam rolling benefits are comparable to PNF stretching in increasing ROM, with no detrimental effects on performance.⁶
- Hamstrings were shown to have a high response to reciprocal inhibition from activation of the quadriceps, whereas the opposite had a low response.⁷
- Similar activation results were found during foam rolling.⁸

PURPOSE AND HYPOTHESIS

Purpose:
To investigate the effects of foam rolling over the quadriceps muscles versus hamstrings muscles on a measure of hamstring extensibility.

Hypothesis:
Hamstring Extensibility will have a greater positive change (increase) acutely following Quadriceps Foam Rolling compared to Hamstring Foam Rolling, which was measured by the 90-90 passive knee extension (PKE) test.

METHODS

Study Design: Pre-test, Post-test, Cross-Over Design

Independent variables: Foam Rolling Intervention (Quadriceps, Hamstrings)

Dependent variable: Passive Knee Extension Test Change Score (Post-Pre)

Subjects: 18-30 years old

Inclusion Criteria: Recreationally active: moderate intensity exercise 3x per week for 30-mins

Exclusion Criteria: Upper or lower extremity musculoskeletal injury, neurological issues, cardiovascular issues, history of musculoskeletal surgery in the past 6 months, or current experience with foam rolling the leg muscles

Passive Knee Extension (PKE) Test: (Figure 1)
- Measurements via bubble inclinometer (Baseline Bubble Inclinometer, Fabrication Enterprises Inc.)
- Inclinometer placed on mid thigh to place the hip of the test leg in 90° of flexion
- PVC pipe apparatus used to assist in keeping the hip at 90°
- Inclinometer placed mid-shank while the investigator passively extended the knee until reaching the maximal tolerable stretch of the hamstring - indicated by participant
- The absolute knee angle was measured with the inclinometer

Foam Rolling Interventions: Explained using a standardized verbal script and a video demonstration. Both interventions include 2 sets, 60-seconds (30-seconds between sets).
- Hamstrings: (Figure 2) Start by sitting on the ground, hands placed behind you, with the roller just below the buttocks with the hips off the ground. Place the non-treatment foot on the ground, and roll down to just above the knee fold and back. Your body weight is supported and maneuvered by the hands, which are behind the body. It should take about 3-seconds to roll down toward the knee and 3-seconds to roll back to the starting position.
- Quadriceps: (Figure 3) Start laying in a face down position with the roller at the highest point of your thigh, place non-treatment foot on the ground, and roll down to a position just above the knee cap and back using hands or elbows to guide movement. It should take about 3-seconds to roll down toward the knee and 3-seconds to roll back to the starting position.

Procedures:
- Hamstrings and Quadriceps Interventions were randomly assigned to each leg of a participant
- Participants performed both interventions in a randomized order with 10-minutes in between.

RESULTS

Statistical Analysis: Pre-intervention PKE values were compared using a paired samples t-test to determine if the 10-minute was out period between interventions (limbs) was effective. Dependent variables were calculated (Post-Pre) and data analysis was performed utilizing a paired samples t-test to identify differences between interventions (IBM SPSS, version 23).

- Participants: n=9 (24yrs ± 2.45yrs), (169.28kg ± 9.06kg), (76.71cm ± 20.32cm)
- No significant difference was observed between the pre-intervention PKE values (t9 = 2.28, p = 0.52).
- No significant difference was observed between quadriceps and hamstring intervention change scores on measures of PKE (t9 = 0.64, p = 0.54).

<table>
<thead>
<tr>
<th>Pre-intervention Mean ± SD</th>
<th>Post-intervention Mean ± SD</th>
<th>Change Score Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quad FR 72.22 ± 13.29</td>
<td>77.74 ± 13.63</td>
<td>5.52 ± 4.24</td>
</tr>
<tr>
<td>Ham FR 69.19 ± 14.42</td>
<td>76.37 ± 11.72</td>
<td>7.19 ± 6.16</td>
</tr>
</tbody>
</table>

Table 1. Means (SD) reported for all time points. Positive change score indicates increased hamstring extensibility.

DISCUSSION AND CONCLUSIONS

- Pre-intervention PKE values were not significantly different, supporting the effectiveness of the 10-minute washout period. Therefore, crossover effects of the foam-rolling intervention did subside following this time period.⁹
- Both interventions increased hamstring extensibility without a significant difference between the two. Therefore, the hypothesis was not supported.
- It is clinically significant that both FR interventions can be used to cause comparable increases in hamstring extensibility.
- Strength of study is currently limited by small sample size.

REFERENCES