Different Effects of Static and Vibrating Foam Rollers on Plantar Flexor’s Flexibility and Torque Production Capacity

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Different Effects of Static and Vibrating Foam Rollers on Plantar Flexor's Flexibility and Torque Production Capacity

An Honors Thesis submitted in partial fulfillment of the requirements of Honors in the Department of Heath and Human Sciences at Georgia Southern University

By
Tanner Cormier
Under the mentorship of Dr. Czech and Dr. Li

ABSTRACT

The purpose of this research was to determine if there were different effects on the range of motion and muscle contraction force in the plantar flexors of the ankle when implementing vibrating foam roller treatment in comparison to static. The study included 15 female swimmers within the age range of 18 to 28 years old without neuromusculoskeletal pathology within the last six months. Each testing session consisted of four conditions, conditions A and B were static rollers and conditions C and D were vibrating rollers. To ensure reliability the order of the conditions was randomly selected and resting flexibility and force production were measured after the resting period in between conditions. The participants began by using their assigned roller for thirty seconds, three times, with fifteen second breaks. Range of motion was measured by a weight-bearing lunge and a tape measure and force was measured by the Biodex using isokinetic and isometric tests. As hypothesized, after using a two-way ANOVA test with repeated measures and a paired T-test for the difference of the difference, there were no significant interactions based on Cohen's D calculations and no significant difference between pre and post results on torque production, but both rollers had a significant enhancement on range of motion.

Thesis Mentor: _________________________
Dr. Daniel Czech

Honors Director: _________________________
Dr. Steven Engel

March 2019
College of Health and Human Sciences
University Honors Program
Georgia Southern University
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Acknowledgments

I would like to express my deepest thanks to my two mentors, Dr. Czech and Dr. Li. They both went above and beyond to make sure I felt challenged yet not overwhelmed. I would not have been able to complete this research project without their continental support and guidance. I would also like to thank my program member Bri Mazzei for providing me with suggestions and uplifting encouragement throughout this process. I will forever be in debt to Georgia Southern for giving me this opportunity to grow my knowledge and develop my first ever research project.
Introduction

Foam rolling is commonly used as a recovery tool. It is a form of self-myofascial release which is when an individual applies a manual treatment to themselves (Beardsley & Škarabot, 2015). In this study, flexibility will be defined as the range of motion available at a joint and torque performance will represent force strength (Anderson & Burke, 1991).

The literature indicates that foam rolling improves flexibility, but does not effect strength (Behara & Jacobson, 2017). Studies have been conducted on different types of recovery tools, foam rolling being one and vibration being another (Jacobs, 2009). There has been no research comparing static to vibrating treatments. The method for measuring range of motion has been represented in previous research and shown to be able to potentially remove restrictions that other types of methods have seen (Kelly & Beardsley, 2016).

Therefore, the purpose of this study is to determine if there are different effects on range of motion and torque production on the plantar flexors of the ankle when implementing static vs vibrating foam rollers. Having research indicate an increase in range of motion for both treatments has created the study comparing if static or vibrating foam roller have different results from one another.
Methods

Participants

Fifteen female swimmers within the range of 18 to 28 years old that had no neuromusculoskeletal pathology within the last six months volunteered for this study. Informed consents were obtained prior to testing. The mean ages were 19.5 years with a standard deviation of 1.3. The mean height was 169 cm with a standard deviation of 3.4. The mean body mass was 66.6 kg with a standard deviation of 4.2.

Materials

Participants used the Biodex to measure torque production and a weight-bearing lunge next to a measuring tape was used to measure flexibility. The Biodex had two tests, isokinetic and isometric. The isokinetic test was done on the dominate leg of the participant and stayed at 90 degrees and measured three forces pushed upon without a bend in the knee. The isometric test done on the same leg also starting at 90 degrees recorded the torque production when the participant plantar flexed and dorsiflexed their foot. The data was recorded in Excel and statically analyzed.

Procedures

Each testing session consisted of four conditions, conditions A and B were static rollers and conditions C and D were vibrating rollers. The researcher was trained by a Biomechanical TA on how to use the Biodex equipment and software. To have a controlled variable to refer the data and ensure reliability, before any testing each participant’s torque production and flexibility were measured.

To measure flexibility, a weight-bearing lunge shown by researcher was done. There was a mark 10 cm away from the wall were the front of the foot was placed. With the non dominant
leg bent, the knee was pressed against wall. The dominate leg stayed straight and the participants on their own slowly pushed back as far as they could without allowing their foot come off the ground or their knee come off the wall. The measure was taken from the 10 cm mark to the front of the dominate foot. The measurement was taken by two researchers to ensure reliability.

To measure torque production, the Biodex was used. The participant sat on the chair with their dominate leg strapped into the equipment. The research gave directions based on which test will be given, isokinetic or isometric.

Depending on the condition being used first, the participant used either the static or vibrating roller. For each roller, the protocol for rolling was the same. In a seated position on the ground the participant’s dominant leg was placed on the roller beginning right below the knee and rolling down to the back of the foot. A metronome was set to a speed of 96 bpm to give the participants a steady motion, changing the direction upon each sound. For thirty seconds they rolled, given a fifteen second break, then repeated three times.

Upon completing the rolling portion both flexibility and torque production were tested. A ten-minute break was taken to ensure the effects of the first trail will not affect the next. Before testing the next condition, flexibility and torque production were measured. The protocol for both rollers was the same. Excel was used to organize results and graph differences.
Results

Reliability

Approval from Georgia Southern University Office of Research services and Sponsored Programs Institutional Review Board (IRB) was obtained prior to conducting the study. Each participant was volunteer-based and anthropometric characteristics were recorded (Table 1.1). Prior to testing each participant read and signed an informed consent. Each participant started with a randomly selected roller. Prior to the use of each roller, flexibility and torque production was recorded to contribute as a baseline.

Table 1.1. Mean and standard deviation of descriptive data of participants.

<table>
<thead>
<tr>
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<th>Mean</th>
<th>SD</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>19.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>169</td>
<td>3.4</td>
</tr>
<tr>
<td>Body Mass (kg)</td>
<td>66.2</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Figure 1.1. Pre and post for static and dynamic range of motion, showing the difference of the differences (*).
Figure 1.2. Pre and post for static and dynamic isokinetic torque production, showing the difference of the differences (*).

Figure 1.3. Pre and post for static and dynamic isometric torque production, showing the difference of the differences (*).

Table 1.2. Cohen’s d calculations (Cohen, 2016).

<table>
<thead>
<tr>
<th></th>
<th>Cohen’s d</th>
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<tbody>
<tr>
<td>Range of motion</td>
<td>0.710</td>
</tr>
<tr>
<td>Isometric</td>
<td>0.168</td>
</tr>
<tr>
<td>Isokinetic</td>
<td>0.030</td>
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</table>
Discussion

The purpose of this study was to show if there was a difference in the effects on the range of motion and torque production on the plantar flexors of the ankle when implementing vibrating foam roller treatment in comparison to static. This study expected to see results of range of motion increasing in both static and vibrating rollers and no change to torque production, showing the reliable of previous research.

For both static and dynamic rollers there was an increase in range of motion (Figure 1.1). Both tests for torque production, isometric and isokinetic, there was minimal change (Figure 1.2 and 1.2). To analyze the data, Cohen’s d calculation (Cohen, 2016) was used and considers 0.20 to indicated a ‘small’ effect size, 0.5 as a ‘medium’ effect size, and 0.8 as a ‘large’ effect size. The Cohen’s d calculations (Table 1.2) show that range of motion had closer to a ‘large’ effect size while both isometric and isokinetic did not even show a ‘small’ effect size.

Possible errors of this study include that the participants were not giving their maximum effort and prior stretching could have influenced results. Although there were limitations and possible errors in this study we believe they did not effect the results. To allow further study on this topic a larger sample size would give a more significant result.
Appendix A

Purpose, Limitations, Delimitations, Assumptions

Purpose
The purpose of this research was to determine if there are different effects on the range of motion and torque production on the plantar flexors of the ankle when implementing vibrating foam roller treatment in comparison to static.

Limitations
• A small sample size of fifteen participants made it difficult to find a significant relationship in the data and not a strong representative of the population.

Delimitations
• The participants were all female in the age range of 18 to 24 years old.
• All participants were full time students at Georgia Southern University.

Assumptions
• The Biodex was a reliable tool for measuring torque production.
• Researchers were successfully trained to operate the program used to conduct results.
• Participants gave maximum effort.
Appendix B

Literature Review

Flexibility and torque production performance effects an athlete’s overall performance. Past research has focused on the difference of foam rolling vs stretching. A study done by (Sullivan, et al 2013) and (Behara & Jacobson, 2017) concluded there was an increase in hamstrings range of motion after foam rolling yet no effect on muscle strength. Both studies have said that both stretching and foam rollers have similar effects and can be used interchangeably. There have been multiple studies concluding that foam rollers have improved range of motion, but there is very minimal research focused on the effect on ankle plantar flexor’s.

Other forms of treatment that have shown an increase in muscle strength and flexibility includes vibration therapy (Jacobs, 2009). There has yet to be a study done that shows the effects of vibration and foam rolling combined. Our study will provide a foundation that will demonstrate additional effects and comparison to past research.

Foam rollers are mainly used by athletes due to the alleged enhancement of flexibility. Having more research can be used in order to decide if foam rolling is effective or something that has just been used because it is a widely known stretch.
References


CONSENT TO ACT AS A SUBJECT IN AN EXPERIMENTAL STUDY

Title of Project: Different Effects of Static and Vibrating Foam Rollers on Plantar Flexor’s Flexibility and Force Production Capacity

Brianna Mazzei and Tanner Cormier, Georgia Southern undergraduate students, will be working under Dr. Li Li during the completion of this research. The purpose of this research is to determine if there are different effects on the range of motion and muscle contraction force in the plantar flexors of the ankle when implementing vibrating foam roller treatment in comparison to static foam roller therapy. You will be a part of a sample of twenty female collegiate swimmers at Georgia Southern University. You will participate in the project and be tested according to assigned data collection sessions. You are eligible to participate in the study if you are a female swimmer within the age range of 18 to 28 years old without neuromusculoskeletal pathology within the last six months. If you answered “Yes” for any of the PAR-Q questions, you will be excluded from the project. There are four conditions in one testing session. Conditions A and B will include static rollers and conditions C and D will implement vibrating rollers. There is no difference between conditions A and B, C and D are the same conditions as well. They are created and included to test the effects of different testing sequences. The order of the conditions will be randomly assigned to each participant. Resting flexibility will be measured upon arrival.
using the weight-bearing lunge technique and a tape measure. Muscle contraction force will be measured using a dynamometer. After 10 minutes rest, the resting flexibility and force production will be measured again in order to evaluate measurement reliability. You will then use the assigned roller for three trials. Range of motion and force production will be measured immediately after the foam rolling procedure and both five & ten minutes post-test. Each session will take no longer than an hour and you will only be required to attend one session.

The minor risks to the study include discomfort and possible pain during data collection. While unlikely, it is possible that you may injure yourself while using the foam rollers, dynamometer, or standing in a weight-bearing lunge position. By signing this consent form, you are agreeing to the following statement: “I understand that medical care is available in the event of injury resulting from research but that neither financial compensation nor free medical treatment is provided.” To minimize the possibility of the unlikely injury, please listen to the instructions carefully at the beginning of the testing session.

The benefits to you participating in the study include learning personal muscle recovery therapy using advanced equipment. The data collected by the researchers could give you insights to muscle recovery treatments that are most beneficial for your needs. You will also be able to get involved in research that may be beneficial to your program of study. The benefits to the society include providing one of the first published research involving the new technology of vibrating foam rollers and their effects on flexibility and muscle force production. These data can benefit sports medicine researchers, strength and conditioning specialists, coaches, physical and occupational therapists, exercise physiologists, and athletes, specifically swimmers.

You should be aware that deidentified coded data from this study will be stored in a password secured computer in a locked office for three years. All the records will be destroyed
three years after the conclusion of the project. Your confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the confidentiality of individuals and institutions.

You also have the right to ask questions and have those questions answered. If you have questions about this study, please contact the researchers named above or the researcher’s faculty advisor, whose contact information is located at the end of the informed consent. For questions concerning your rights as a research participant, contact Georgia Southern University Office of Research Services and Sponsored Programs at 912-478-5465.

There will be no compensation for volunteering for the data collection of the research study. You as a volunteer are not required to participate in the research and you may end the testing session at any time by notifying the researcher in charge. There is no penalty for not participating in the study and you may withdraw at any time without retribution. You must be 18 years of age or older to consent to participate in the study. If you wish to consent to participate and to the terms stated above, please sign and indicate the date.

You will be given a copy of this consent form to keep for your records. This project has been reviewed and approved by the GSU Institutional Review Board under tracking number H18164.

Investigators:
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Tanner Cormier, 904-236-2407, tc04707@georgiasouthern.edu
Research Advisor: Dr. Li Li, 912-478-0200, lili@georgiasouthern.edu

I, the undersigned, verify that the above informed consent procedure has been followed.

____________________________________  __________  ______________
Participant Signature  Date