



The Effects of a Gluteus Medius Training Protocol on Muscle Activation

Dorpinghaus ND, Gage MJ, Dominguese D, Kingsley D, Yoder A
Indiana State University

Abstract

Context: Researchers have suggested that a weak or dysfunctional gluteus medius (GM) has been linked to a number of lower extremity injuries. Identifying an appropriate intervention to prevent or correct deficits of the GM and determine associated outcomes has become a subject of increased interest. **Objective:** To determine if GM training changes lower extremity muscle activation during a dynamic task. **Design:** Controlled laboratory study **Setting:** Biomechanics research laboratory. **Participants:** Eighteen healthy, physically active participants (7 men, 11 women; age = 21.2 ± 2.01 yrs; height = 168.39 ± 8.92 cm; mass = 77.76 ± 16.39 kg) volunteered for the study. All participants served as their own control. **Intervention(s):** All of the participants completed a six week GM training protocol. Muscle activation of 5 trunk muscles were measured bilaterally before and after the protocol during a single-leg drop landing and normalized. **Main Outcome Measure(s):** Peak and mean muscle activation was measured 400ms pre- and post-landing. **Results:** Decreased muscle activation was observed in the right GM [pre-mean ($P=.001$), pre-peak ($P=.007$), post-mean ($P=.033$), and post-peak ($P=.045$)]. Increased biceps femoris (BF) mean muscle activation was observed on the stance leg pre-landing ($p=.044$). **Conclusions:** Six weeks of GM training was enough time to observe improved GM neuromuscular efficiency. The increased BF muscle activation prior to landing suggests participants had an increased feedforward response in preparation for landing. Therefore the combination of improved neuromuscular efficiency and a greater feedforward response suggest pelvic stabilization may be improved during a single-leg drop landing as a result of six weeks of GM training.

Methods

Inclusion criteria:

- Physically active (cardio for 30 minutes, 3 times per week).
- Between 18 and 30 years of age.
- Range of motion within normal limits.
- Strength testing within normal limits.

Exclusion criteria:

- History of cardiovascular, neurological, or childbirth/pregnancy within the past year.
- History of abdominal, low back, or lower extremity injury within the past year.
- Restriction from physical activity or surgery with the past two years.
- Unresolved lower extremity injury or current pain in the spine, abdominal, or lower extremity.
- Missing two or more training sessions.

Independent variables:

- Six week GM training protocol
- Time

Dependent variable:

- Muscle activation (5 trunk muscles)
 - Gluteus Medius (GM)
 - Transversus abdominis/internal oblique (TrA/IO)
 - Vastus medialis (VM)
 - Biceps femoris (BF)

Methods

Timeline:

Familiarization Session

Data Collection Session 1

- Performed within 2 days of familiarization session.

Data Collection Session 2

- Performed 2 weeks after data collection session 1.

GM Training Protocol

- Began after data collection session 2.

Data Collection Session 3

- Performed upon completion of GM training protocol.

Procedures:

Familiarization Session

- Completion of informed consent and health history questionnaire.
- 5 minute warm-up on cycle ergometer.
- Leg dominance was determined as the leg the participant uses to stand on while kicking a ball.
- Three practice trials of single-leg drop landing (SLDL) at half of testing height (30cm) and three practice trials at testing height (45cm).
- All SLDL trials were completed on dominant leg.

Data Collection Sessions

- Completion of 5 minute warm-up on cycle ergometer.
- Skin was shaved if needed, debrided with fine sand paper, and cleaned with alcohol.
- Electrodes placed in parallel arrangement over muscle according to referenced muscle placement.
- Maximal Voluntary Isometric Contraction (MVIC) testing.
- Completion of SLDL (3 trials).

GM Training Protocol

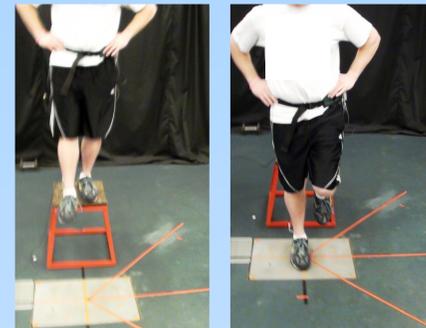
- Completed 3 times per week for 6 weeks.
- Participants reported to the research lab for one training session per week.
- Remaining two training session were completed without supervision.
- Participants reported training sessions and additional physical activity in weekly exercise log.

Statistical Analysis:

- Repeated measures Analysis of Variance (ANOVA) were used to determine differences in muscle activation between each data collection session.
- Alpha set at $<.05$

Electrode Placement

Muscle	Anatomical landmarks
Gluteus medius	One third the distance from the iliac crest to the greater trochanter, starting from the greater trochanter.
Transverse abdominis/Internal oblique	Approximately 2 cm medial and inferior to the right anterior superior iliac spine.
Vastus medialis	52mm from the superior medial side of the patella along a line medially oriented at an angle of 50° with respect to the anterior superior iliac spine.
Biceps femoris	One third the distance from the ischial tuberosity to the lateral side of the popliteus cavity, starting from the ischial tuberosity.



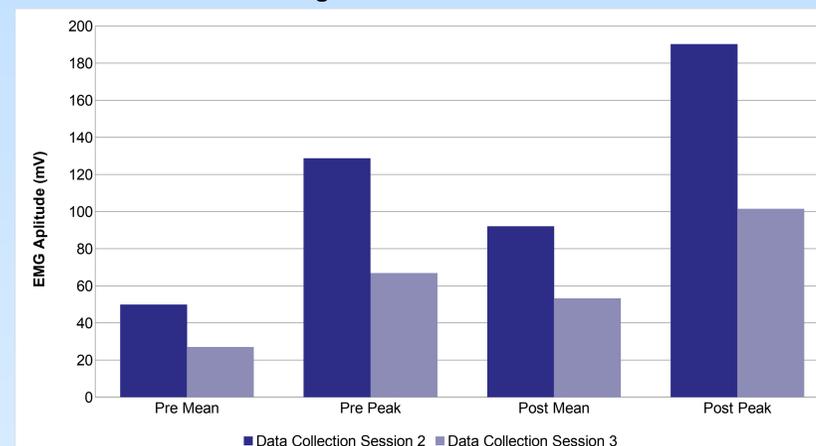
Single-leg drop landing

GM Training Protocol

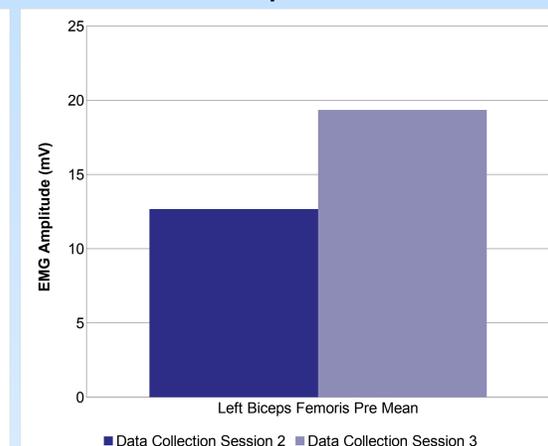
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Wall Squat	1x10	1x15	1x15	2x10	2x15	3x15
Forward Step-Up	10	15	15	2x10	2x15	3x15
Side-lying hip abduction	10	15	2x10	2x10	2x15	3x15
Wall Press	20 sec	30 sec	30 sec	2x20 sec	2x30 sec	3x20 sec
Single-leg deadlift	5	8	8	2x5	2x8	3x8
Single-leg squat	-	5	8	2x5	2x8	3x8
Sideways hop	-	-	8	12	2x8	2x12

Results

Right Gluteus Medius



Left Biceps Femoris



- Decreased muscle activation was observed in the right GM.
 - Pre-mean ($F=14.30$, $P=.001$)
 - Pre-peak ($F=9.49$, $P=.007$)
 - Post-mean ($F=5.37$, $P=.033$)
 - Post-peak ($F=4.68$, $P=.045$)

- Increased BF mean muscle activation was observed on the stance leg pre-landing ($F=4.75$, $P=.044$).

Conclusions

- The decreased muscle activation observed in the right GM (non-stance leg) demonstrates improved neuromuscular efficiency. It is commonly accepted that decreased muscle activation demonstrates increased muscle recruitment, increased muscle synchronization, and greater efficiency of motor pathways. Thus, six weeks of GM training was enough time to observe improved GM neuromuscular efficiency.
- The increased BF muscle activation prior to landing suggests participants had an increased feedforward response in preparation for landing. This finding is consistent with the need to control lower extremity positions and maintain the center of mass within the base of support.
- The combination of improved neuromuscular efficiency and a greater feedforward response suggest pelvic stabilization may be improved during a single-leg drop landing as a result of six weeks of GM training.



*This project was made possible thanks to financial contributions from Indiana State University's College of Graduate & Professional Studies and the Graduate Student Association.