Effect of Foot Placement on Recruitment of the Gluteus Medius During a Barbell Squat

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Background Information

- Previous studies
  - Activation of the trunk stabilizers (Bressels et al. 2009)
  - EMG activation during different squats (Miller 2019)
  - Activation of muscles of the lower limb due to variations in foot placement and squat depth (Clark 2012)

- Focus
  - Gluteal activation patterns and foot placement
  - Rehab and fitness protocols want to utilize ideal exercise form and position to target specific muscles

*The American College of Sports Medicine provides detail in appropriate loads and guidelines for performing squats.
Project Purpose

- Evaluate the effect variations in stance width has on gluteal and quadriceps muscle activation during a barbell back squat
  - Specifically, we studied the muscle activation of the gluteus medius and rectus femoris muscles

- Determining a foot placement that targets the hip and quadriceps muscles the most will give insight into the safest and most effective way to exercise these muscles
Subjects or Study Population

Requirements:

- College students - must be at least 18 years old
- Must have no acute injuries, lifting, or exercise restrictions
- No strenuous exercise training within 24 hours prior to participation
- Must wear gym shoes and gym shorts

Time commitment:

1-day commitment - approximately 30-minute session

Subjects will perform a variety of barbell squats while hip-muscle activation patterns are measured via surface EMG.


Study Design

- Cross-Sectional Study
  - Both empirical and quantitative
- Participants were asked to come in one time only
  - Performed all tasks in one visit
  - Roughly 30 minute intervention overall
Methods

1. All subjects signed informed consent prior to participating
2. 5-minute warm-up
3. Surface EMGs on gluteus medius and rectus femoris on left leg
4. Participants performed 3 sets of 8 barbell squats with 50% bodyweight loaded on the bar
   a. Set 1: completed with feet at hip width
   b. Set 2: each foot positioned ~1.5 inches wider (3 inches wider than hip width)
   c. Set 3: each foot positioned ~3 inches wider (6 inches wider)
5. EMG data was collected during each squat sequence
Equipment

- Squat rack/weights
- EMG (computer system, sensors, etc.)
- Measuring tape
- Spotters
Assessment

- Quantitative (mV)
- Average activation of gluteus medius and rectus femoris
- Activation patterns across different stances
- Male vs. female activation
Results

- No Outliers
- Found average activation (mV) for each muscle in each stance
- Compared average activation (mV) in males and females
- Isolated the subjects that showed consistent trends
  - Calculated the change in activation in these subjects
  - Identified any patterns in the directions of the trends
Average Muscle Activation per Stance

<table>
<thead>
<tr>
<th>Foot Placement</th>
<th>Rectus Femoris</th>
<th>Gluteus Medius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip Width</td>
<td>1.31</td>
<td>1.12</td>
</tr>
<tr>
<td>Hip + 3in</td>
<td>1.36</td>
<td>0.99</td>
</tr>
<tr>
<td>Hip + 6in</td>
<td>1.28</td>
<td>0.78</td>
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</table>
# Trends in the Data

<table>
<thead>
<tr>
<th></th>
<th>RF</th>
<th>GM</th>
<th>Both</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
<td>8</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Positive</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Negative</td>
<td>3</td>
<td>5</td>
<td>4</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Rectus Femoris</th>
<th>Gluteus Medius</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 inches</td>
<td>6 inches</td>
</tr>
<tr>
<td>Average Change (mV)</td>
<td>-0.01</td>
<td>-0.15</td>
</tr>
</tbody>
</table>
Discussion

- Previous studies demonstrated a wider foot stance increases hip muscle activation during a squat.
- Males vs Female muscle activation patterns

  - **Strength** - reproducible
  - **Weakness** - sample size

- Challenged by technology

- Barbell back squat may not be best for strengthening gluteus medius
Conclusions

- Miniscule changes in muscle activation
  - Wider stance = more Rectus Femoris activation
- Males Generate more force with Rectus Femoris than Gluteus Medius in our project

- Not enough data to verify results
Future Direction

- Continue testing variation of squats to determine ideal techniques for muscle activation.
  - Foot Placement, Load, Duration, Type of Squat

- Core activation and contribution? Other Muscles?

- Experienced vs Inexperienced Lifter?
Acknowledgements/Questions/Comments

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