The Impact of Collegiate Soccer Training on Gastrocnemius Activation

Ali Quillen
Valparaiso University, ali.quillen@valpo.edu
The Impact of Collegiate Soccer Training on Gastrocnemius Activation

Ali Quillen; Kelly Helm PhD
Valparaiso University Department of Kinesiology

Abstract
This study examined the impact of a collegiate soccer practice on freshman female’s gastrocnemius activation while performing a power jump, as measured by surface EMG. The muscles analyzed included the R & L medial and lateral gastrocnemius. The null hypothesis stated that no significant difference in gastrocnemius activation would be found between post and pre-practice. Participants completed three countermovement box jumps, with a 20-second rest between trials. Muscle signals were processed and sent to EMGworks® Analysis Software for assessment. The root mean square (RMS) of each MVIC was calculated and the greatest MVIC across all three scores was used for

Introduction
Chelly et al. (2010) explained collegiate soccer training as a combination of strength, power, jumping ability and acceleration. Jumping aptitude and anaerobic performance are critical for the ability of soccer players to perform at their greatest potential. Soccer involves short-term muscle power and explosive movements which are demanded in tackling, heading, frequent kicking and changing of pace throughout the game.1 Plyometric exercises often incorporated within a soccer training program, are used for increasing dynamic athletic performance, like vertical jump height, agility and lower extremity muscle activation.2 Hamilton, Weinar and Luttgens (2016) discussed the importance of performing a bilateral countermovement jump by defining its role in activating major lower-limb muscles, including the gastrocnemius. By using a bilateral jump, like a box jump, a significant number of lower-limb muscles can be recruited and activated.3 Research that implemented an additional eight-week plyometric training program for collegiate soccer athletes, in-season, showed a significant increase in jump height, average jump power, and running velocities.4 An increase in countermovement jump power but not peak force was shown, implying that the increased power produced was from an increase in peak velocity.5 Behman and Sale (1993) suggested that the increase of leg power was a result from selective activation of muscles and increased recruitment of motor units.4 An increased recruitment of motor units leads to improved muscle efficiency and economy of motion, leading to increased athletic performance and reduced muscular fatigue from training.3

Methods

Setting
• Small D1 private Midwestern University
• Human Performance Lab
• Spring 2020

Participants
• 6 freshman Division I female soccer players

Procedures
• Five-minute warm-up on bicycle ergometer.
• Skin surface above right and left medial and lateral gastrocnemius muscles was prepared and secured with electrode sensors.
• 3 MVIC’s followed by 3 countermovement box jumps were performed and video recorded.
• Surface electrodes detecting muscle activity sent data via Bluetooth to computer program.
• A paired two samples mean t-test was done for each muscle to test for significance between pre- and post-practice muscle activation.

Figure 1 Loading Phase
Figure 2 Landing Phase

Figure 3 EMG of Right and Left Medial Gastrocnemius Pre- and Post-practice
Figure 4 EMG of Right and Left Lateral Gastrocnemius Pre- and Post-practice

Results

Table 1 Mean Pre-Post Percent MVIC Lateral Gastrocnemius Activity

<table>
<thead>
<tr>
<th></th>
<th>n Left Gastrocnemius</th>
<th>Right Gastrocnemius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Pre (%) Δ Post (%)</td>
<td>365.9</td>
<td>279.6</td>
</tr>
</tbody>
</table>

Table 2 Mean pre-post percent MVIC Medial Gastrocnemius Activity

<table>
<thead>
<tr>
<th></th>
<th>n Left Gastrocnemius</th>
<th>Right Gastrocnemius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δ Pre (%) Δ Post (%)</td>
<td>97.8</td>
<td>94.1</td>
</tr>
</tbody>
</table>

Table 3 t-Test: Paired Two Sample for Means

<table>
<thead>
<tr>
<th></th>
<th>LLG Pre &amp; Post</th>
<th>LMG Pre &amp; Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>0.25</td>
<td>0.36</td>
</tr>
<tr>
<td>df</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.52</td>
<td>0.71</td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.57</td>
<td>2.57</td>
</tr>
</tbody>
</table>

No significant differences in muscle activity between pre- and post-training of the left lateral and medial gastrocnemius was found for the countermovement jump.

Acknowledgements
I would like to thank Dr. Helm for helping me complete all my data collection and for the many hours she put into assisting me with data analysis and organization. I would also like to thank the six participants on the women’s soccer team for participating in my study and their Head Coach for allowing them to participate. Lastly, I am thankful for my classmates Cody Delloway, Ryan Gneid, Darby Klum and Ben Anspach for their assistance in data collection and preparation and Terrence Wade for his help with statistical analysis and SPSS programming.

Conclusion
Comparison of pre- and post-practice gastrocnemius activation indicated no statistically significant results between pre- and post-practice, for any of the four muscles analyzed. The results do not support research that indicate that the subjects’ improved their exercise economy and reduced fatigue levels, leading to improved performance.5 Researchers concluded that the 90-minute soccer practice did not have a significant impact on gastrocnemius activation, as measured during a box jump. Therefore the null hypothesis was accepted. Further research is needed with a larger sample size and more specific training intervention.

References

Table 4 Paired Two Sample for Means

<table>
<thead>
<tr>
<th></th>
<th>RLG Pre &amp; Post</th>
<th>RMG Pre &amp; Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>0.77</td>
<td>0.88</td>
</tr>
<tr>
<td>df</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>P(T&lt;=t) two-tail</td>
<td>0.98</td>
<td>0.55</td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.57</td>
<td>2.57</td>
</tr>
</tbody>
</table>

Table 1

Table 2

Table 3

Table 4

Figure 4