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Ali Quillen

Valparaiso University, ali.quillen@valpo.edu

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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. Subjects included six, freshman, female collegiate soccer players. Delsys Trigno® Wireless sEMG system was used. Electrodes were placed on bellies of gastrocnemius. 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 normalization. The box jumps were normalized to the greatest MVIC across all three jumps for each muscle and the maximum amplitude from each jump was expressed as a percentage of the MVIC. A paired two samples mean *t*-test indicated no significant differences in muscle activity from pre to post-practice box-jumps. Therefore, the null hypothesis was accepted. A recommendation for this study would be to assess the difficulty of the 90-minute practice as well as possibly assess different muscles for comparison.

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, Weimar and Lutgens (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.¹ 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.¹ 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.⁵

Figure 1 Loading Phase



Figure 2 Landing Phase



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.

Results

Table 1

Mean Pre-Post Percent MVIC Lateral Gastrocnemius Activity

n	Left Gastrocnemius			Right Gastrocnemius		
	Pre (%)	Post (%)	Δ	Pre (%)	Post (%)	Δ
6	69.5	79.6	21.5	97.3	97.5	18.2

Table 2

Mean pre-post percent MVIC Medial Gastrocnemius Activity

n	Left Gastrocnemius			Right Gastrocnemius		
	Pre (%)	Post (%)	Δ	Pre (%)	Post (%)	Δ
6	97.8	94.1	17.3	83.6	88.3	14.1

Table 3

t-Test: Paired Two Sample for Means

	LLG Pre & Post	LMG Pre & Post
Pearson Correlation	0.25	0.36
df	5.00	5.00
P(T<=t) two-tail	0.52	0.71
t Critical two-tail	2.57	2.57

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 Dolloway, Rianna Gesell, Darby Kloweit and Ben Anspaugh for their assistance in data collection and preparation and Terrance Wade for his help with statistical analysis and SPSS programming.

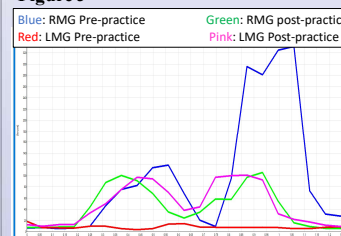
Results cont.

Table 4

t-Test: Paired Two Sample for Means

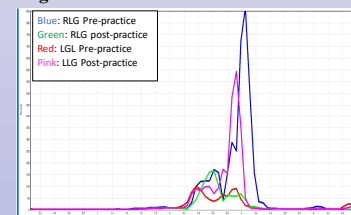
	RLG Pre & Post	RMG Pre & Post
Pearson Correlation	0.77	0.88
df	5.00	5.00
P(T<=t) two-tail	0.98	0.55
t Critical two-tail	2.57	2.57

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

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.

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