Peak Electromyography Activation Is Not Augmented In The Gluteus Maximus And Rectus Femoris Muscles With Variations In Back Squat Exercises

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INTRODUCTION

Barbell back squat is used in a variety of settings from strength and conditioning to rehabilitation and is a staple in most programs. However, variations in squat loading exist to strengthen muscles of the gluteal and quadriceps groups. Advances in the measurement of muscle activation during dynamic movements give us the ability to compare muscle activation techniques across back squat variations.

The purpose of this study is to compare muscle activation of the gluteus maximus (GM) and rectus femoris (RF) in three back squat loading variations: barbell back squat (BS), barbell with chains (CH), and safety bar squat (SBS)

METHODS

Participants:

- Eleven healthy males and females who have barbell back squatted at least 1x per week for the past 6 months volunteered for this study.
- Data was filtered to only include subjects with complete contraction EMG details
- (n=10; 23±5.5 years; 168.37±14.099 cm; 75.789±14.206 kg)

Protocol/Data Collection:

- Study consisted of 3 testing sessions. For all sessions, EMG bi-polar electrodes were placed over the GM & RF.
- Session 1: 1RM back squat was established via National Strength and Conditioning Association (NSCA) guidelines
- Participants completed a 5-minute warmup on stationary bike, followed by participants' dynamic warm up of choice.
- Session 2: 1RM safety bar squat was established via NSCA guidelines. Participants completed a 5-minute warmup on stationary bike, followed by participants' dynamic warm up of choice.
- Session 3: 3 different squat variations, in a randomized order, were performed at 80% of 1RM (back squat, safety bar squat, chains [40lbs]) with 10 minutes of rest between each variation.

Analysis:

- Data was processed via Delsys software using EMG root mean square (EMGrms).
- All contractions were normalized to their respective 1RM back squat activation.
- A 2x3 (muscle x variation) ANOVA was run to analyze differences, with a-priori p-value set to 0.05.

BACK SQUAT VARIATIONS

Back Squat (BS)

Chains (CH)

Safety Bar Squat (SBS)

Peak EMGrms does not differ between back squat variations at 80% of 1RM

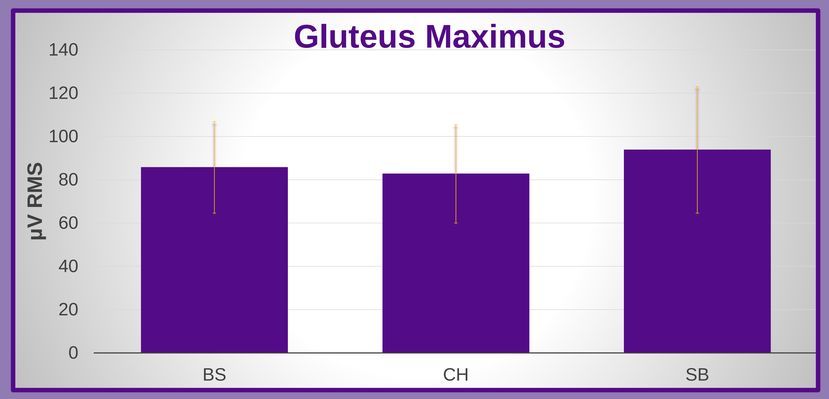


Figure 1: Mean peak EMGrms for GM; BS (87.29 ± 21.6mV) CH (82.21 ± 23.42 mV) SBS (96.08 ± 50.41 mV)

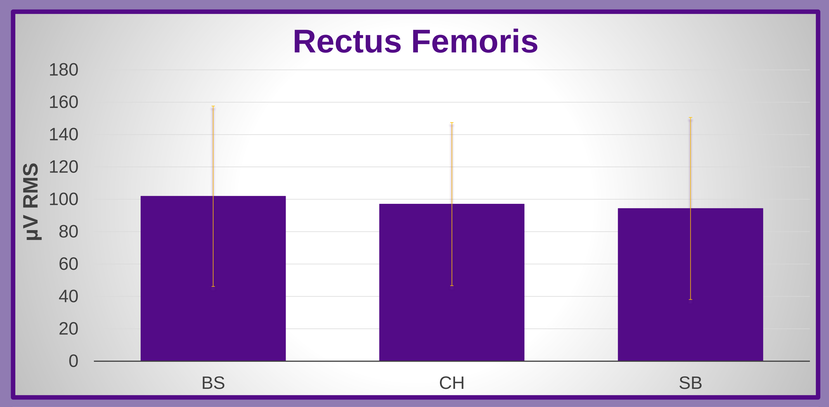


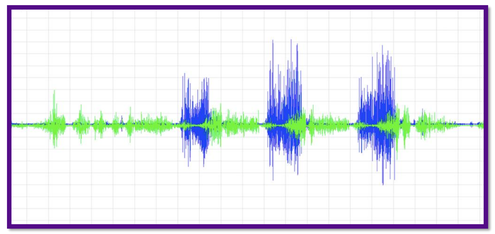
Figure 2: Mean peak EMGrms for RF; BS (101.89 ± 55.73 mV) CH (97.04 ± 50.41 mV) SBS (94.34 ± 55.25 mV)

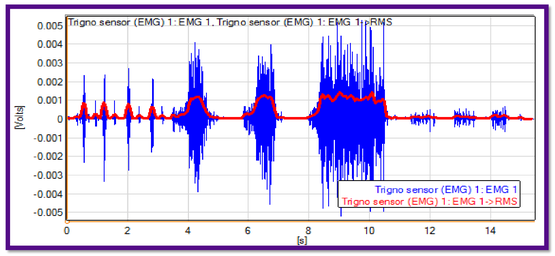
RESULTS

- No significant main effects or interactions between back squat variations and muscle groups examined (p=0.76, p=0.42).
- Mean peak EMGrms for GM; BS (87.29 ± 21.6mV) CH (82.21 ± 23.42 mV) SBS (96.08 ± 50.41 mV).
- Mean peak EMGrms for RF; BS (101.89 ± 55.73 mV) CH (97.04 ± 50.41 mV) SS (94.34 ± 55.25 mV).

CONCLUSIONS

This data indicates that there are no differences in peak activation of the GM and RF during a set at 80% of 1RM for BS, SBS and CH. These findings are consistent with previous literature where no statistical differences were found between the front squat, BS and squats at various depths[1,2]. EMG analysis beyond peak EMGrms during should be further explored along with increased sample size for further exploration of body positioning and coactivation techniques.





Images (from top left): *Delsys Trigno Bi-polar electrode, Delsys software EMG analysis raw EMG, Delsys software EMGrms analysis.*

PRACTICAL APPLICATION

Practitioners may use these findings to implement variations of the back squat into rehabilitation and strength and conditioning programs to elicit similar activations in the GM and RF under a moderate load (80%) using CH, SBS or BS.

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