TACSM Abstract

Lower Limb Muscle Activity and Recruitment Patterns Measured via Electromyography in Back Squat Variations

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ABSTRACT

The squat is a fundamental exercise performed by athletes to improve muscular fitness. There are many variations of the back squat including the chained squat, box squat, and barefoot squat. Strength training literature recommends the inclusion of proper squats for athletes as well as variations of the squat to improve adaptations. Several studies have been published that analyze the neuromuscular relationship using electromyography (EMG) but few studies exist that compare EMG responses between squat variation. **Purpose:** Thus, the purpose of this investigation was to compare the electromyography (EMG) amplitude of the gluteus maximus (GM), biceps femoris (BF), and vastus lateralis (VL) during a back, chained, barefoot, and box squat. **Methods**: Seven college-aged resistance trained volunteers, three men and four women (age 21.4 ± 0.98; height 166.87 ± 12.84cm; weight 77.44 ± 18.52kg; percent body fat 22.97 ± 9.51 BF%) were recruited for this study and completed a baseline testing session to determine 70% of their 1 repetition maximum (1RM) and familiarize subjects with the squat variations: box, barefoot, back, and chained squats. Following the first testing session, each subsequent session occurred after a one-week washout period. EMG testing sites were located at each session via anatomical landmarks and palpation then abraded prior to applying surface electrodes in a bipolar configuration. Using the BIOPAC MP3X and Biopac system software, EMG activity was recorded through an integrated, high pass frequency filter. Participants performed 5 sets of 10 repetitions for each randomly assigned squat variation and data was analyzed for peak and mean values from the 1st set. Frequencies were normalized and recorded in millivolts (mV). The values from the subjects' dominant leg were then analyzed using a one-way ANOVA with a p-value of <0.05 was set to determine the level of statistical significance. **Results**: No significant differences were observed between back squat variations for both peak (VL: $p = 0.817$; BF: $p = 0.941$; GM: $p = 0.766$) and mean (VL: $p = 0.877$; BF: $p = 0.738$; GM: $p = 0.602$) EMG values. VL mean activation values (mean±SD) were as followed for the squat variations: back 0.254 ± 0.164, barefoot 0.297 ± 0.179, box 0.337 ± 0.239, chained 0.294 ± 0.155. VL peak activation values (mean±SD) were as followed for the squat variations: back 0.522 ± 0.335, barefoot 0.652 ± 0.395, box 0.720 ± 0.486, chained 0.650 ± 0.320. **Conclusions:** Despite varying levels of VL peak activation, this data suggests EMG activity for each muscle group does not seem to vary significantly between the squat variations used in this study. Data was collected from each leg which could be used in a future study to identify imbalances when compared to leg dominance across squat variation. The results could be applied clinically and practically in that multiple back squat variations can elicit similar muscular activation levels in a resistance-trained population.