COMPARISON OF HEX BAR DEADLIFT VS. BACKSQUAT POSTACTIVATION POTENTIATION ON VERTICAL JUMP GROUND REACTION FORCE

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INTRODUCTION: Coaches are searching for the best way to train their athletes to be bigger, faster and stronger. Research is also investigating new ways to manipulate training to produce an increase in performance. The vertical jump is important in numerous sports such as volleyball, basketball, soccer, or any explosive movement that uses triple extension. It is also used as a test of lower limb power. One unique form of training to increase power is postactivation potentiation (PAP), which has been largely researched using heavy resistance back squats (Mangus et al., 2006, Weber et al., 2013).

The phenomenon of PAP is based on the premise of performing a heavy resistance exercise, followed by an explosive exercise. The mechanism behind PAP has been reported to be phosphorylation of myosin regulatory light chains, a Ca^{2+} dependent process (Chiu et. al., 2003), and increased motor unit recruitment (Tillin et al., 2009). Thereby, muscular performance is acutely enhanced following a relatively high intensity activity (e.g. 1 repetition max (1-RM) back squat performed before a vertical jump (VJ)) (Chiu et al., 2003; Evetovich et al., 2014; Gourgoulis, et al., 2003). Training status, rest period, volume and intensity have all been shown to affect PAP. Chiu et al., 2003 found that force and power parameters were more enhanced in athletes when compared to recreationally trained individuals. Other research has shown vertical jump increases due to PAP (Gourgoulis et al., 2003; Wilson et al., 2013).

The back squat is one of the most commonly used training exercises performed by fitness enthusiasts, and athletes. Numerous prior studies have used the back squat as an exercise to elicit PAP (Crewther et al., 2011; Evetovich et al., 2014). However, little research has investigated the deadlift exercise on PAP production. Traditionally, deadlifts are performed with a standard barbell, but recent research has demonstrated that use of a hexagonal (hex) barbell results in greater force, power, and rate of force development (RFD). (Swinton,et al., 2011; Harmon et al., in review,). The design of the hex bar is theorized to place the lifter in an advantageous position while reducing external forces and risk of injury to the lumbar spine (Camara, et. al., in review, Malyszek et. al, in review). Therefore, the purpose of this study was to compare the potentiating effects of a back squat (BS) vs. hex bar deadlift (HBDL) on peak ground reaction force (GRF).

METHODS: Ten resistance-trained men (age=23.36±3.80 years, ht=175.50±4.22cm, mass=79.53±5.28kg) volunteered to participate. They performed a dynamic warm-up consisting of alternating leg swings, knee pulls, and walking lunges for a distance of 10 meters. Days one and two involved testing baseline countermovement vertical jump (CMJ), and one repetition maximum (1-RM) of either (HBDL1-RM: 356.00±46.89kg) or high bar back squat (BS1-RM: 284.00±48.64kg). Days 3, 4, and 5 were 48-72 hours later and included the same dynamic warm-up as day one and two. Three pre-CMJ were measured followed by 3 repetitions at 85% of either HBDL, BS, or control. All conditions were counterbalanced. Eight minutes (Wilson et al., 2013) standing rest was then given followed by 3 post-CMJ. A control condition consisted of 3 pre-CMJ, 8 minutes standing rest, followed by 3 post-CMJ. To perform the CMJ, participants jumped with arm swing (in order to be similar to a basketball rebound jump) on a force plate. Peak ground reaction force was calculated as the highest force output of the force- time trace

prior to take-off. The BS was performed with a standard barbell in a power rack. Participants wore a safety squat device which ensured they achieved quadriceps parallel to the ground position. For HBDL, participants used the low handles, and were not allowed to use straps because not all subjects were familiar with straps. All procedures were approved by the University Institutional Review Board for human subjects. Participants signed an informed consent prior to testing, and were asked to refrain from lower body high intensity training 48 hours prior to each session.

RESULTS: Data was evaluated for outliers and none were found. Data was normally distributed. Two-way repeated measures ANOVA analyzed pre and post CMJ peak GRF (ICC=0.93) and revealed a significant interaction of condition and time (p=.034*)*.This was followed-up by three dependent t-test (Tukey's correction) comparing pre and post for each condition. Results demonstrated a significant (p=0.004, d=0.4) decrease in peak ground reaction force following the back squat; BS (pre 2253.23±224.76N, post 2157.19± 192.33N) with no statistical change in control (pre 2194.80±174.45N, post 2188.73± 141.94N) or HBDL (pre 2191.36± 193.44N, post 2180.64± 188.64N).

DISCUSSION: Our results demonstrated a decrease in GRF only following the BS with no change in the other conditions. Manipulation of critical variables determines PAP outcomes. A meta-analysis of PAP by Wilson et al., 2013 found that in order for PAP to occur, critical variables such as intensity, volume, and rest need to be chosen carefully. PAP response is also known to be highly individualized. Training age of our subjects may have been low leading to a decrease in performance. Jump mechanics might have also been a reason for the decrease in peak ground reaction force. The intensity (85%1RM) of the BS protocol might also have been too high or the rest time too short or too long for these subjects. The proper balance between fatigue and potentiation is required or high levels of fatigue can occur in less trained individuals. In order for there to be an increase in performance, PAP needs to exceed fatigue (Jo et. al. 2010). Higher trained individuals can benefit from a shorter recovery time while less trained individuals require longer recovery times. Crewther et. al., 2011 found that a single set of 3RM squats was effective at enhancing CMJ height, and even more effective when they individualized the recovery time for each athlete. Future research should continue to investigate the proper balance between intensity, volume and rest to optimize PAP in different lifts.

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