ROLE OF TRUNK MUSCLE CO-CONTRACTION DURING DJ FROM DIFFERENT HEIGHTS AND INSTABILITY CONDITIONS

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Introduction
Neuromuscular control of trunk is associated with parameters of dynamic knee stability during jumps (Prieske et al., 2013). For instance, insufficient trunk stability, unstable surfaces, different heights and gender predicts higher knee impact loads. This study investigates gender differences relating to the association between trunk muscle co-contraction and 3D lower body biomechanics during drop jumps (DJ) from different heights with and without instability condition.

Methods
3D full body kinematics (Qualisys) and electromyographic (EMG) activity (Noraxon) of trunk muscles (m. erector spinae (ES) and m. rectus abdominis (RA)) were recorded in physically active subjects (n=43 age 19.4±3.9 y, 27m, 16f) performing DJ with their right leg on a force plate (Bertec) from different dropping heights (H1=0, H2=15, H3=30 cm) under stable and unstable (AIREX balance pad) condition (SC, ISC). Peak knee valgus moment within 30% of contact time (KVMmax) was elected for analysis of knee, because of its relevance to knee impact load. Furthermore, ratio between normalized ES and RA activity (RESRA) as trunk muscle co-contraction value were calculated when KVMmax occurs. Pearson’s correlation between RESRA and knee stability parameter (knee flexion angle (KFA), knee valgus angle (KVA), knee flexion moment (KFM), knee valgus moment (KVM)) were analyzed for m and f subjects, respectively. For all statistical analysis alpha=0.05 was accepted as level of statistical significance.

Results
Under SC there is no significant correlation for any parameter of knee stability, whether for gender nor for different dropping heights. For ISC, significant correlations were found between RESRA and KFA in both, men l: 62<r<79, p<.05 and women -68<r<78, p<.05. KVA shows a significant correlation only for females in H1 (r=-.78, p<.01). When regarding KFM there is high correlation in men in H2 (r=-.82, p=.001) and a moderate correlation in women in H3 (r=.52, p<.01). No correlations could be found for KVM.

Discussion
First, KFA is decreased with higher RESRA which means that activity of ES was higher than RA and less co-contraction occurs. Referring to this, it could be assumed that trunk stability is lacking and hence decreased KFA seems to be of higher knee injury risk. Secondly, there are only limited findings on KVA and KVM, which imply that knee stability parameter are less affected by trunk stability during DJs. Finally, compared to gender differences RESRA and KFM display a negative association in men for H2 and positive in women for H3. This reveals that there could be a different biomechanical or neuromuscular strategy between gender. The present findings suggest that trunk muscle co-contraction is a predictor of trunk stability is of higher interest in ISC with increased dropping heights.

References

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POTENTIATING EFFECTS OF FREE WEIGHT AND ELASTIC BAND BACK SQUAT EXERCISES ON SUBSEQUENT VERTICAL JUMP PERFORMANCE

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Introduction
Performing maximal or near-maximal contractions during a warm-up can induce short-term increases in force production, a phenomenon termed as post-activation potentiation (PAP). Varying the load during a back squat using elastic bands (EB) in combination with free-weight resistance (FWR) can manipulate the loading characteristics of the lift. This may enhance total muscle force production (impulse), and thus muscle work, and hypothetically augment the PAP response. Therefore, the aim of this study was to examine the influence of EB during warm-up squat exercises on subsequent vertical jump (VJ) performance.

Methods
Fifteen active men (age = 21.5 ± 3.9 y, height = 1.8 ± 0.7 m, mass = 77.2 ± 9.5 kg) volunteered for the study. On two separate occasions, participants performed a comprehensive warm-up of 5 min cycling, and 10 continuous unloaded squats, 5 continuous vertical jumps at ~70% of maximum, followed 30 s later by maximal jumps performed every 30 s until 3 jumps were performed within 3% of jump height. After 30 s, participants then performed 3 repetitions of either EB or FWR back squats at 85% 1-RM (35% of load generated from elastic resistance during EB). VJ were then performed 30 s, 4 min, 8 min, and 12 min later. Motion analysis and two force platforms recorded kinetic and kinematic data, with vastus lateralis (VL), vastus medialis (VM), gluteus maximus (Glut), and gastrocnemius (GM) electromyograms (EMG) simultaneously recorded during the VJ. Repeated measures ANOVA’s were used to examine differences between conditions; significance was accepted at p<0.05.

Results
A significant increase in VJ height (6.4-9.3%), net impulse (3.2-4.1%), peak power (4.4-6.2%) and peak knee angular velocity (3.0-4.1%) in the concentric phase was found at 30 s, 4 min and 8 min following the EB condition, with no change in maximum knee flexion angle. A significant increase in mean concentric VL EMG was also found at the same time points (21.3-24.6%) following EB. Nonetheless, no significant change in knee height was observed after the FWR warm up.

Discussion
VJ performance was significantly increased following the warm-up with additional elastic band resistance during the squat exercise, but not in the free-weight squat condition. The increase in EMG amplitude in the concentric phase indicates that greater muscle activation may have played a role in the response, resulting in an increase in movement velocity, net impulse and power. As no change was found in FWR, elastic band use could provide for a more effective warm-up prior to athletic performance.

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