The Relationship among Trunk Strength, Trunk Power, and Knee Kinematics during a Stop Jump-Cut Maneuver

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Context: Core strength and stability have been advocated by healthcare professionals and strength and conditioning specialists to optimize performance and reduce the risk of injury/reinjury, including non-contact anterior cruciate ligament (ACL) injury. However, little research exists examining how components of core stability are related to lower extremity kinematics, particularly those that have been identified as related to ACL injury risk. Understanding these relationships may provide insight into which components of core stability should be included when designing training and intervention programs. Objective: To determine the relationship among trunk strength, trunk power, and knee kinematics during a stop jump-cut maneuver (SJCM). Design: Cross-sectional study. Setting: Sports Medicine Research Laboratory. Participants: A total of 53 healthy, physically active college-aged males and females (age: 22.0±2.1 years; height: 172.5±8.4 cm; mass: 71.6±10.4 kg) participated. Interventions: Isokinetic trunk flexion/extension (TFlex/TExt) and right/left rotation strength (RTR/LTR) were assessed using an isokinetic dynamometer (60°/s, 5 repetitions each). Trunk power was assessed using the front abdominal power throw (FAPT) and the side abdominal power throw (SAPT) (2 kg medicine ball, 3 repetitions each). Knee kinematics were assessed during a SJCM (3 trials) using a 3D motion analysis system (200 Hz) and force plate (1200 Hz). For the SJCM, the subject jumped off of two feet from a distance of 40% his/her height, landed on the dominant leg on the force plate, and immediately performed a 45° cut and 2.5 m run away from the stance leg. Main Outcome Measures: Average peak torque was calculated for TFlex, TExt, RTR, and LTR. For FAPT and SAPT, the average distance of three trials was calculated. Knee kinematics included knee valgus angle at initial contact (KVIC), total knee valgus excursion (TKVE), and knee flexion angle at initial contact (KFlexIC) during the SJCM. All data were assessed for normality using Shapiro-Wilk tests. Pearson and Spearman rho correlation coefficients were calculated for normally and non-normally distributed variables, respectively. Statistical significance was set at p<0.05 a priori. Results: All strength measures were significantly correlated with TKVE (r: -0.358 to -0.470, p<0.009), KFlexIC (r: 0.366 to 0.428, p<0.007), and FAPT (r: 0.580 to 0.627, p<0.001). Additionally, TFlex was significantly correlated with LSAPT (r=0.727, p=0.049) and RTR was significantly correlated with RSAPT (r=0.296, p=0.032). The FABT was significantly correlated with TKVE (r=-0.30, p=0.029). No significant correlation was found between KVIC and any variable. Conclusions: Trunk strength is important in reducing total knee valgus motion and increasing knee flexion at initial contact during a SJCM. Trunk power was related to trunk strength, but not knee kinematics, potentially limiting the use of such field tests as proxy measures of strength. These findings substantiate the relationship between trunk strength and knee kinematics, supporting the importance of inclusion of core strengthening in injury prevention/rehabilitation programs. Word Count: 450