Title:
The relationship between lower extremity strength and lower extremity kinematics at the hip, knee and ankle during plié and relevé in professional dancers

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Abstract:
Dancers sometimes display movement patterns that put them at risk for injury; examples being excessive pronation/supination of the foot, valgus/varus of the knee, or tilting and leaning of the trunk and pelvis. These motions may be associated with weakness of lower extremity musculature. 20 professional dancers (14 females, 6 males; mean age=23 years, range 18-31 years) performing classical ballet (10), contemporary ballet (8), modern (2) were included in this study. All dancers completed the University informed consent prior to participating. Isometric strength of hip abduction, adduction, internal rotation and external rotation, knee flexion and extension, and ankle inversion and eversion were collected using a handheld dynamometer. The average peak force of three trials was reported normalized to the dancers’ body weight. Dancers performed three unilateral pliés in parallel and turned out positions, and relevés in parallel on each leg. Lower extremity kinematics were collected with the Vicon 3D Infrared Optical Capture System. A custom Lower Extremity Plug in Gait Model with the addition trunk markers and the Oxford Foot Model was used. A custom MatLab script was used to calculate maximum values of trunk (flexion/extension and lateral lean), pelvis (flexion/extension and lateral lean), hip (abduction/adduction), knee (varus/valgus), ankle (inversion/eversion), rearfoot to tibia (inversion/eversion) and forefoot to rearfoot (pronation/supination) position and reported in degrees. Spearman correlation coefficients were calculated and determined to be significant with alpha=0.05. For the plié in parallel task pelvis lateral lean was correlated with multiple hip strength variables (r range 0.486 to 0.512, p<0.05) and hip abduction/adduction with hip abduction strength (rho=-0.462, p<0.05). For the plié in turned out task pelvis flexion/extension was correlated hip and knee strength variables (rho range -0.526 to -0.589, p<0.05). For the relevé task pelvis lateral lean and hip abduction/adduction were correlated with multiple strength variables at the hip knee and ankle/foot (rho range 0.467 to 0.679, p<0.05). It appears that lower extremity strength is correlated with movements considered to be risk factors for lower extremity. Dancers who demonstrate weakness may benefit from strengthening programs directed at multiple sites to help prevent risky movement patterns.