An integrated biomechanical analysis of high speed incline and level treadmill running.

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Abstract:

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Purpose: Recent sprint training regimens have used high-speed incline treadmill running to provide enhanced loading of muscles responsible for increasing forward running speed. The goal of this study was to document the joint kinematics, EMG, and swing-phase kinetics of incline treadmill running at 4.5 m[middle dot]s-1 with a 30% grade, and compare these data to that of level running under similar conditions.

Methods: Sagittal plane video (200 Hz) and EMG from eight lower extremity muscles were recorded during each of three locomotion conditions: incline running at 4.5 m[middle dot]s-1 and 30% grade (INC), level running at 4.5 m[middle dot]s-1 (LSS), and level running at the same stride frequency as INC (LSSF). A rigid body model was used to estimate net muscle power and work values at the hip, knee, and ankle during swing. Timing and amplitude of EMG signals for each muscle relative to footstrike were compared between conditions.

Results: Stride frequency and percentage of stride spent in stance were significantly higher during INC (1.78 Hz; 32.8%) than in the LSS (1.39 Hz; 28.8%) condition. Stride frequency played an important role, as most measures were more similar between INC and LSSF. Extensor range of motion of all joints during push-off was higher for INC. During INC, average EMG amplitude of the gastrocnemius, soleus, rectus femoris, vastus lateralis, and gluteus maximus were higher during stance, whereas the hamstrings activity amplitudes were lower. Average power and energy generated during hip flexion and extension in the swing phase were greatest during INC.

Conclusions: These data suggest that compared with LSSF and LSS, INC provides enhanced muscular loading of key mono- and bi-articular muscles during both swing and stance phases.