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KINEMATICS AND NEUROMUSCULAR RECRUITMENT OF VERTICAL TREADMILL RUNNING

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Introduction

A vertical treadmill (VT) is being developed for the physical conditioning or rehabilitation of athletes. It requires a running action in a recumbent or supine position on a vertically hung, non-motorised treadmill whilst the limbs are supported with overhanging resistance cables. The aim of this study was to describe the kinematics and neuromuscular recruitment pattern of VT running.

Methods

Thirteen active males aged 24.8 (7.1) years, height 1.8 (0.1) m, body mass 77.7 (8.8) kg undertook two familiarisation sessions to determine self-selected (SS) running speed. On a third visit, at the SS running speed, sagittal plane kinematics of the ankle, knee and hip were collected using a motion capture system (200Hz). Activation of major leg muscles was determined by synchronised electromyography.

Results

Participants adopted a SS running speed of 2.12 (0.38) m/s and a cadence of 150 (20) steps/min. with a stance phase of 32.9 (6.6)% of the gait cycle. Ranges of motion at the ankle, knee and hip were 29.8 (3.6), 38.9 (8.7) and 34.8 (6.6)° respectively. The hamstrings were active between 0-30% of gait cycle and again at 57-100%. Gastrocnemius (GA) were both active 0-49% and 68-100%. Tibialis Anterior was active 0-8% and 15-100%. Rectus Femoris (RF) was active between 10-83% of gait cycle.

Discussion

VT running elicits similar SS speed (2.25m/s, Koga et al. 2009) and stance phase (31.1%, Mann et al., 1980) to horizontal treadmill running. During VT running, the hamstrings pull the leg against the treadmill and resistance cables. RF initiates in stance to flex the hip and to control hamstring activity which ceases in late stance, thus hip hyperextension does not occur (peak extension 0.3 (5.7)°) as observed in horizontal running (Mann et al., 1980). GA activity and peak plantarflexion (20.4 (4.9)°) after toe off indicate a propulsion phase seen in horizontal running (Mann et al., 1980). However, the muscular force is likely not as high due the absence of body mass loading. In swing, peak knee flexion (64.4 (8.1)°) was driven by the RF flexing the hip, not by hamstring activity. In late swing the RF extended the knee alone since the Vasti muscles were inactive. The results indicate that VT running targets muscles associated with the posterior chain that are essential for running performance and injury prevention (Askling et al., 2003). In conclusion, the VT shares many similarities with horizontal running without impact loading thus it might be appropriate for injury rehabilitation and physical conditioning for overground running.

References

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