MUSCLE ACTIVITY DURING BEAM WALKING IN NOVICE AND EXPERT SUBJECTS

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INTRODUCTION: Ankle injuries are a common cause of working days lost in the British Armed Forces. In this study we are comparing the activity of muscles acting about the ankle when walking on a normal floor surface with that when walking on narrow beams and lines. This may help elucidate how the ankle responds to unexpected perturbations, which often cause ankle injury. Beam walking is a good model for investigating the control of the ankle, as it is a challenging motor task that involves aspects of both balance and agility. The difficulty and danger of the task can be modified independently, by adjusting the width and height of the beam. Previous work (Llewellyn *et al*, 1990) has shown that greater co-contraction of the *tibialis anterior* and *triceps surae* muscles occurs during beam walking compared with treadmill walking. This co-contraction may allow the neuromuscular system to stabilise the ankle by increasing joint stiffness. In addition, studies of reflex activity during walking (Prochazka *et al*. 1988, Llewellyn *et al* 1990) showed that whilst both the static and dynamic sensitivity of muscle spindles is *enhanced* during balancing tasks, the actual reflex response to perturbations is *reduced* when compared with normal walking. The CNS is able to increase spindle sensitivity to enhance sensory input, whilst reducing the gain of the stretch reflex, thus limiting any destabilising consequences of an enhanced reflex response.

METHOD: Subjects will comprise 4 groups each of ten subjects: novice males, novice females, expert males and expert females. Experts have specific training or experience of gymnastics. Novices have no such training or experience. Subjects are fitted with surface electrodes over *soleus*, *flexor hallucis longus*, *peroneus longus* and *tibialis anterior* muscles of the dominant lower leg. EMGs are amplified, filtered (F_c=300Hz) and full-wave rectified. Force data is recorded by a force plate (Kistler 9281B) located centrally in the walkway. Data are sampled at 500 Hz per channel (CED1401+ ADC). The 600-mm long section of the line, strip or beam located on the force plate is mechanically isolated from adjoining structures. Switches on the heel and metatarsal head detect stance and swing phase. Subjects make (in random order) 10 repetitions of each of the following tasks: a) walking on a floor, b) walking on a 50 mm wide line on the floor, c) walking on a 50 mm wide beam raised 20 mm above the floor and, d) walking on a 50 mm wide beam raised 600 mm above the floor. After each walk, the subject rates the difficulty of the task using a numerical scale.

RESULTS: Novice subjects show greater ($p>0.05$) soleus and tibialis anterior co-contraction during stance phase of strip and beam walking (balancing tasks) than during stance phase of normal and line walking (non-balancing tasks). Flexor hallucis longus and peroneus longus show reduced activity during stance phase of balancing tasks compared with non-balancing tasks ($p>0.05$). Thus changes in activation do not result simply from altered limb kinematics. Deviations in medio-lateral force and increased ratio of stance to swing duration confirm greater instability during balancing tasks ($p>0.05$). Results from expert subjects are being gathered, but we hypothesise they will show reduced levels of co-contraction compared with novices. Whilst changes in muscle activation may provide appropriate modulation of the mechanical characteristics of the ankle during balancing, over extended periods, they may have consequences for injury as a result of fatigue.

REFERENCES:

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