JOINT LOADING OF OLDER AND YOUNGER ADULTS WHEN NEGOTIATING STAIRS OF DIFFERENT DIMENSIONS

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Introduction

One third of people over the age of 65 fall every year, rising to 50% for people over 80 years old [Age UK, 2010]. The consequences of these falls also increase in severity with age [National Safety Council, 2004], and falls are the leading cause of accidental death in people over 75 years old. A large number of falls occur while negotiating staircases with ⅔ of these occurring during descent [Startzell, 2000], increasing the likelihood of sustaining a serious injury. Difficulties with stair negotiation in old age are likely to be multifactorial and linked to age-related functional impairments, such as reduced muscle strength [Tinetti, 1988]. The present study manipulated the dimensions of a staircase; specifically by altering the step rise (height) and step going (tread), to investigate their influence on lower limb joint moments.

Methods

Nineteen older (mean age 74 years) and 20 younger adult (mean age 29 years) participants ascended and descended a seven step, custom-built, adjustable staircase. Participants were asked to perform trials at a self-selected pace and strategy on 6 different stair configurations. Kinetic data were obtained from force plates embedded in the staircase and a motion analysis system allowed kinematic data to be acquired. Knee and ankle joint moments were calculated using inverse dynamics techniques from the kinetic and kinematic data. Maximum joint moments were assessed using a dynamometer and compared to joint moment data during stair negotiation to estimate joint loading safety reserves.

Results

The study showed that during stair ascent, a higher rise increased how close to their maximum capacity both older and younger adults operated at the ankle and knee joints. Reducing the going allowed older adults to increase their safety reserve at the ankle. During stair descent knee joint moments operated at a consistent percentage of maximum ability for both older and younger adults. Increases in riser height resulted in an increase in the percentage of maximum capacity utilised (lower safety reserve) at the ankle joint in older and younger adults. Reductions in going resulted in a decrease of maximum capacity utilised for both populations at the ankle. Knee joint moments remained at a constant level when compared to maximum ability for both populations and across all configurations. Ankle joint moments were consistently at a higher proportion of maximum ability during ascent and descent and in both older and younger groups. This difference was more pronounced during descent.

Discussion

When step height was increased, all adults operated at a higher proportion of their maximum capacity during ascent and descent in order to meet the increased demands of raising or lowering their body mass by an increased distance. The reduction in the proportion of maximum capacity used at the ankle when the going was reduced was most evident in descent and could result partly from a change in foot placement strategy as the available tread becomes less than the length of the foot. As stair configurations are altered the ankle joint appears to be the chosen joint to accommodate these different demands. This is identified by its large variation in the proportion of maximum capacity utilised by both populations compared to the relatively consistent proportion of maximum capacity used at the knee joint.

References

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