

DETERMINING THE OPTIMAL TENSION FOR AN ANKLE-FOOT ASSISTIVE DEVICE

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Abstract

Introduction

Peripheral artery disease (PAD) is caused by atherosclerosis, a buildup of cholesterol and fatty acid deposits, which blocks blood flow to the arms, legs, and feet. Ankle assistive devices have recently been implemented in various clinical population to improve walking ability. Our group has developed an ankle assistive device to improve walking ability in patients with PAD. This study tested our newly developed assistive device with several tension assistance levels and their effect on metabolic cost.

Methodology

Ten healthy subjects were recruited for this study. A spring was attached to the posterior side of the device parallel to the calf muscles to provide assistance. Subjects walked on an instrumented treadmill for trials lasting five minutes. Metabolic data was recorded using a portable metabolic cart. Metabolic cost was determined as the mean VO₂ of the final two minutes of the walking trials. Each subject repeated the test for 4 conditions: walking without the device i.e. normal walking and walking with three different assistance levels. Different tension assistance levels were achieved by changing the spring stiffness (light, medium, and stiff).

Results and Discussion

Our results showed no significant change in metabolic cost across tension assistance levels compared to the normal walking condition. The light and medium tension assistance levels reduced the average metabolic cost by 0.0096ml/kg/min and 0.02548ml/kg/min respectively, whereas the stiff tension assistance increased metabolic cost by 0.64938ml/kg/min. This result suggests that there may be an inverse U relationship between spring stiffness and the corresponding change in metabolic cost.