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IN VIVO FASCICLE LENGTH OF THE GASTROCNEMIUS MUSCLE DURING WALKING IN SIMULATED MARTIAN GRAVITY USING TWO DIFFERENT BODY WEIGHT SUPPORT DEVICES

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INTRODUCTION:
The effect of unloading upon locomotion is of particular interest for rehabilitative gait training as well as exploration of partial gravity environments. In rehabilitation, unloading is often achieved by lower body positive pressure whereas for spaceflight horizontal suspension combined with a subject loading system has proven to be a suitable analogue for walking in partial gravity. As the plantar flexors are anti-gravity muscles contributing significantly to vertical support and horizontal progression of the human body (Lai et al., 2015), it is important to examine the behaviour of their fascicles under unloading conditions. Therefore, the aim of this study was to compare two different body weight support systems with regard to changes in fascicle and muscle-tendon-unit (MTU) length of the gastrocnemius medialis (GM) during walking at simulated Martian gravity (0.38g).
METHODS:
Eight male subjects (31.9 ± 4.7 yrs) walked at 75% of their preferred walk-to-run transition speed at 0.38g on the vertical treadmill facility (VTF) and the anti-gravity treadmill AlterG. In addition, a control condition without unloading was performed on the AlterG. GM fascicles were scanned and measured with ultrasonography. Plantar pressure and joint kinematics were analysed to determine gait-cycle events and GM MTU length. A non-parametric multiple comparison test for dependent samples was used to test whether changes in fascicle and MTU length are significantly influenced by the different walking conditions.
RESULTS:
None of the three walking conditions had a significant effect on MTU and fascicle excursion or ankle and knee joint range of motion. However, with both devices, fascicles operated at longer length in the middle of the stance phase ($p \leq 0.0179$) and maximum MTU shortening velocity was significantly lower ($p = 0.0027$) in simulated 0.38g. No differences were found when comparing the effect of VTF and AlterG on the tested parameters.
CONCLUSION:
The effect of unloading on fascicle behaviour was similar on the VTF and AlterG, meaning that both devices are equally suitable for body weight supported gait training. The longer fascicles and reduced maximum MTU shortening velocity under simulated Martian gravity compared to walking without unloading, suggests that the tendon must be shorter due to the reduced body weight and hence stored less energy, which can contribute to forward progression.

Reference
Lai, A., Lichtwark, G. A., Schache, A. G., Lin, Y. C., Brown, N. A., & Pandy, M. G. (2015). J Appl Physiol, 118(10), 1266-1275.

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