Final report

Influence of different shoe configurations on the activity pattern of selected leg and torso muscles

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Summary
In this study, surface EMG was used to examine the muscular activity of selected muscles in the legs, hips, and the torso while walking on a treadmill with defined walking speeds. The evaluation was completed using a control shoe and the "Emotion" and "Motion" models from Joya International AG worn by 47 test subjects of both genders with an average age of 50 years. Already during the static test situation involving calm standing, 5 of the 12 muscles examined allowed the influence of the shoe model to be identified, while there was no relevant influence on the body, and only 2 of the examined muscles indicated notable differences with respect to gender. The observed effects showed a tendency to increase the anti-gravitational muscles in the legs versus the control shoe for the Motion model, while the differences fluctuated for the Emotion model. In the torso area, both Joya models tended to reduce amplitude versus the control shoe.
For the dynamic component of the examination, there were also no relevant differences between the sides, however gender specifics were identified for 3 of 12 muscles. With one exception (LO), the variance analysis for the median amplitude values delivered a significant influence of the shoe model, which exhibited interaction with the speed for 9 of the 12 muscles. Therefore, the influence of the shoe model cannot be generalised readily for all walking speeds.
The median amplitude values for anti-gravitational muscles of the calf muscle (FL, LG, MG) and for the examined torso muscles (MF, LO, OI, OE) always exhibited the maximum median amplitude values for the Motion model, while in the case of the Emotion model, the lowest median amplitude values were recorded. In the case of the control shoe, the thigh muscle and the hip (VM, VL, GM) nevertheless exhibited the highest median amplitude values, while the Emotion model continued to display the lowest values. A deviating sequence of median amplitude values only resulted for the TA, since the lowest values resulted for the Motion model in this case, followed by the Emotion model. For the TA, the control shoe exhibited the highest median amplitude values. As expected, the median amplitude level increased for all of the examined muscles with rising speed, and the size of the level increase was nevertheless very different independent of the shoe model and fluctuated between 10-15% for the GM and 200-250% for the VM. These various amplitude increases caused energetic optimums for the CMAPD that was also calculated, i.e., for the exertion per distance covered, which were identified between 3 (MG) and 6 km/h (GM).
With regard to analysis of the amplitude gradient curves, an influence of the shoe model was identified during the initial and median standing phase in particular, especially in the calf muscle. The systematic differences observed primarily followed the tendencies previously identified for the median amplitude values, whereby systematic differences were often not able to be identified due to the extremely high requirements on the level of significance. An amplitude increase was able to be recorded most frequently for the Motion model compared to the control shoe (FL, LG, MG, VM). Nevertheless, the opposite effect was also observed, whereby both Joya models exhibited reduced amplitude values versus the control shoe (TA, VL, BF, GM, MF). In the case of the contraction indices of the formed pair of antagonists, systematic differences were only recorded on the calf muscle. In this case, the analysis essentially resulted in reduced contraction activity of the Emotion model versus the control shoe during the median standing phase, while the Motion model consistently exhibited clearly higher values versus 2 of the control shoes, but also versus the Emotion model during the initial standing phase. This result is the best way to generalise the different mode of action of both shoes: compared with the control shoe, the Emotion model practically caused a systematic and clear reduction of the muscular stabilisation exertion during the completed median standing phase versus the control shoe, while the Emotion model in particular demanded increased stabilisation exertion from the calf muscles during the initial standing phase.
More proximally, these effects were only able to be proven less strongly.

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