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Assessing the potential influence of different walking strategies on plantar pressure distribution triggered by a portable biofeedback-based gait training device

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Study Overview: In this study, a portable biofeedback-based gait training device is developed to advocate able-bodied subjects to adopt different movement patterns in walking to manipulate the plantar pressure distribution under the foot. The corresponding relationship between joint coordination and pressure redistribution pattern was obtained, which could potentially be used in gait retraining interventions to correct abnormal plantar pressure patterns in people with diabetes.

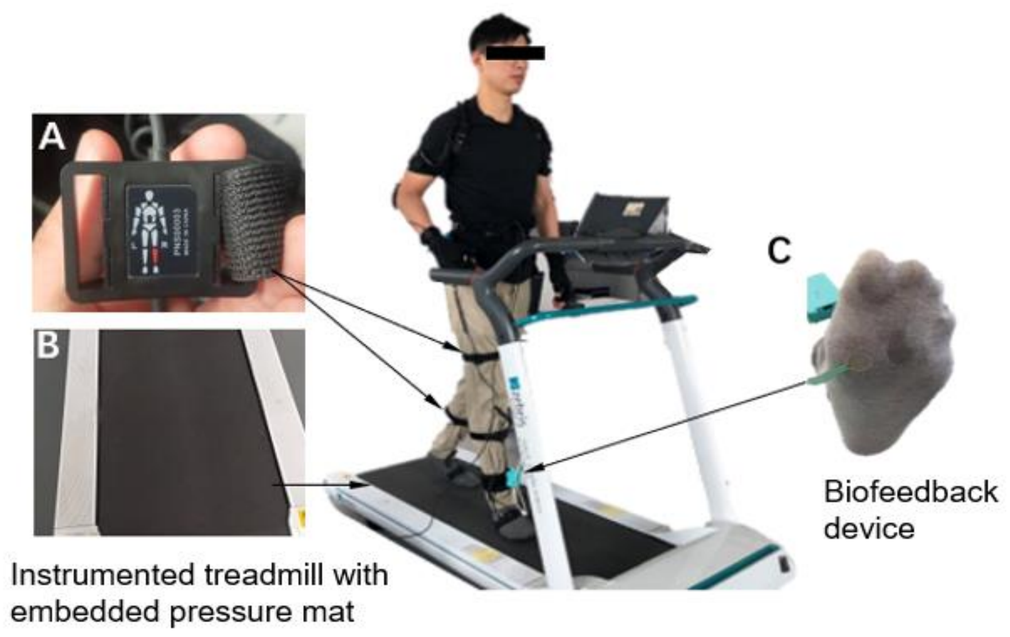

Figure1.Experiment setting for simultaneous acquisition of lower extremity joint kinematics and dynamic plantar pressure distribution during biofeedback-assisted gait training

Figure 1 shows the experimental setup for the three testing groups:

A. Perform only one gait type, i.e. normal walking, and the data collected was used as a basis for comparison.
B. With biofeedback vibration signals, accomplish three self-adjusting walking patterns in order to reduce the peak plantar pressures at three specific sites, namely the heel, the 1st and the 5th metatarsal heads.
C. Completed the decompression task for the specific plantar site only through a self-awareness adjustment but without biofeedback vibration signals.

Figure 2 shows the subjects' foot pressure redistribution pattern (i.e., percentage changes) through self-awareness and biofeedback-assisted adjustment strategies. It can been seen that, in order to reduce the pressure of the first metatarsal site, the pressure peak of the forefoot was shifted to the middle and rearfoot, and the proportion of loads imposed onto the middle foot was significantly increased.

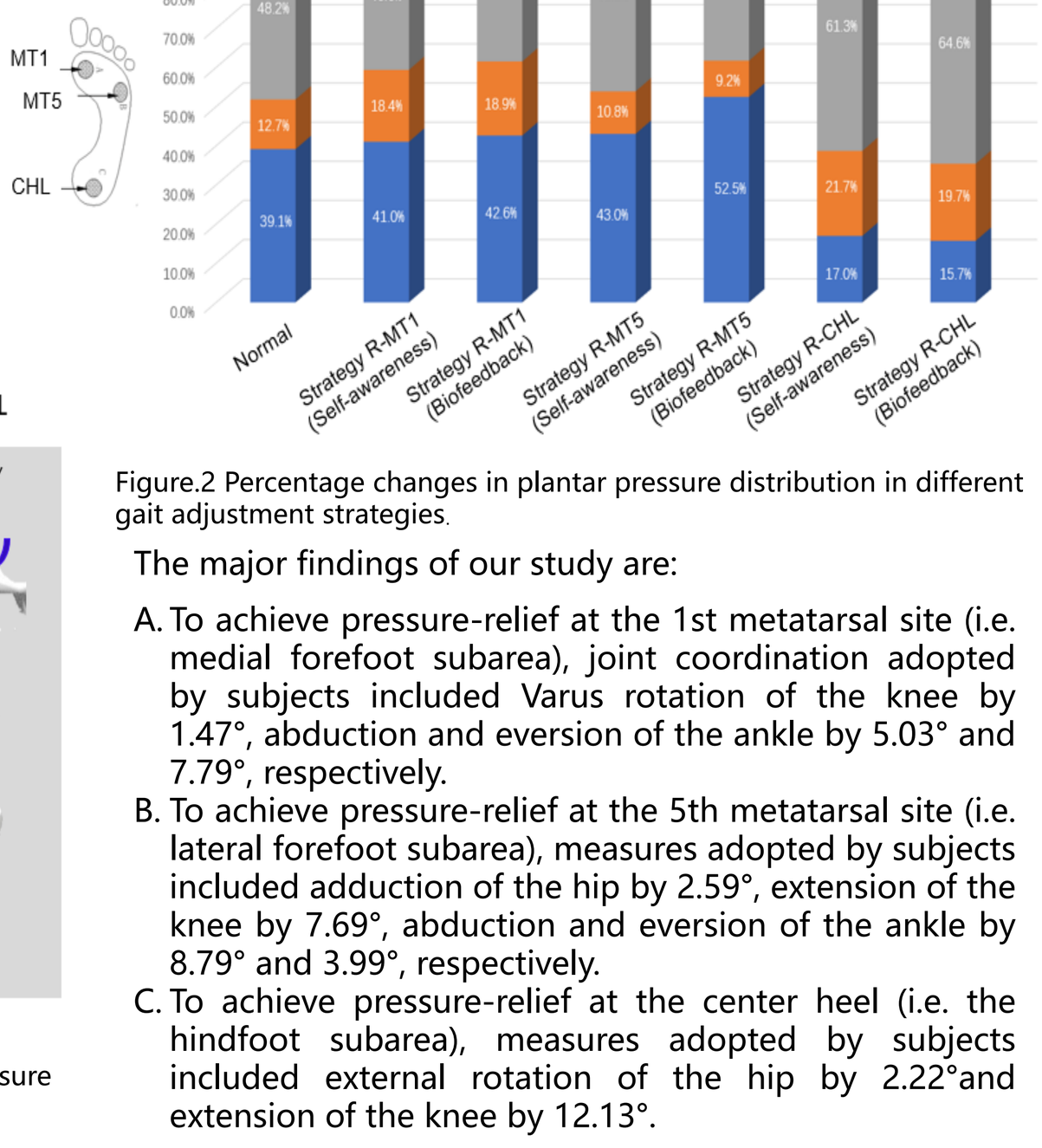

Figure.2 Percentage changes in plantar pressure distribution in different gait adjustment strategies.

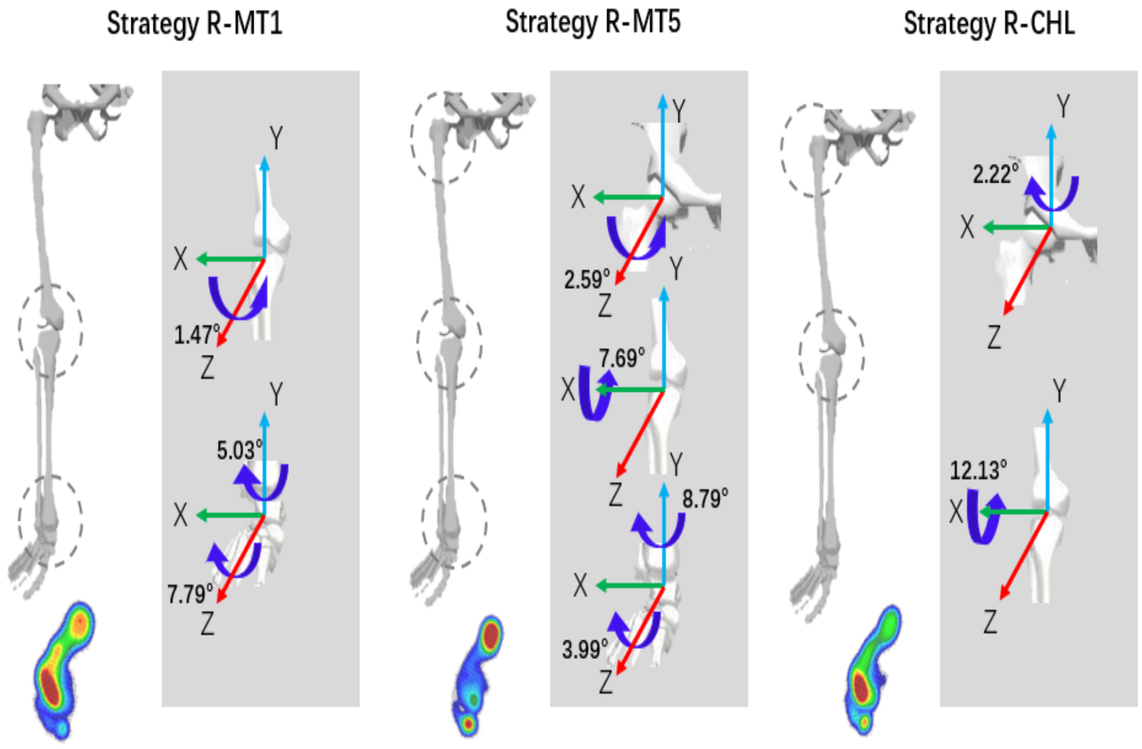

Figure.3 Changes of lower extremity joint angle and dynamic plantar pressure distributions corresponding to different walking strategy.

The major findings of our study are:

A. To achieve pressure-relief at the 1st metatarsal site (i.e. medial forefoot subarea), joint coordination adopted by subjects included Varus rotation of the knee by 1.47°, abduction and eversion of the ankle by 5.03° and 7.79°, respectively.
B. To achieve pressure-relief at the 5th metatarsal site (i.e. lateral forefoot subarea), measures adopted by subjects included adduction of the hip by 2.59°, extension of the knee by 7.69°, abduction and eversion of the ankle by 8.79° and 3.99°, respectively.
C. To achieve pressure-relief at the center heel (i.e. the hindfoot subarea), measures adopted by subjects included external rotation of the hip by 2.22°and extension of the knee by 12.13°.

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