EFFICACY OF THE OPENSIM SIMULATOR AS A TOOL TO DETECT CHANGES IN GAIT: A PERIPHERAL ARTERY DISEASE MODEL

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INTRODUCTION

Peripheral Artery Disease (PAD) is characterized by atherosclerotic plaques in the leg arteries. A common treatment for PAD is supervised exercise training [1]. However, gait is not fully restored following supervised exercise training (SET). Musculoskeletal simulation may provide insight into how muscle activation changes following SET contributed to persistent gait alterations.

METHODS

Kinematic and kinetic data from overground walking of patients with PAD (n=12), before and after a 6-month exercise intervention, was used as input for musculoskeletal modeling (OpenSim). The subjects in our sample were subdivided based on the location of ischemic muscle pain, as reported on the San Diego Claudication Questionnaire. Virtual models were scaled to match the anthropometry of the subjects before muscle parameters were derived. Muscle activation was analyzed across the stance phase of gait and the output was analyzed across subjects and conditions.

RESULTS AND DISCUSSION

The subset of subjects that reported an attenuation of thigh pain as a result of SET (pain-free, n=4) showed a significant increase in late-stance knee flexor force, whereas the group that experienced no difference in thigh pain following SET (pain, n=8) did not demonstrate a significant change in knee flexor force. A significant positive association exists between the difference in absolute claudication distance and the difference in maximum knee flexor force.

CONCLUSIONS

This study demonstrated that a subset of patients with PAD experienced a significant increase in knee flexor force as a result of SET. Simulations may be an effective tool for understanding gait changes in a PAD model.

REFERENCES

[1] N. M. Hamburg and M. A. Creager, "Pathophysiology of intermittent claudication in peripheral artery disease," Circ. J., vol. 81, no. 3, pp. 281–289, 2017, doi: 10.1253/circj.CJ-16-1286.

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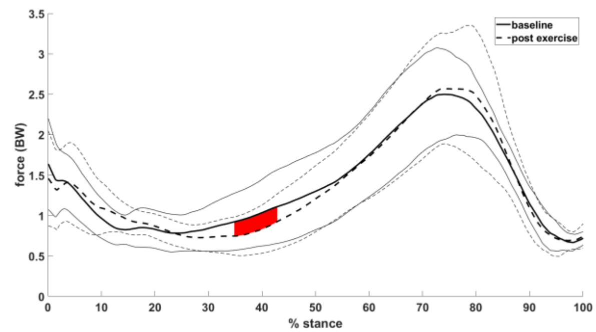

Figure 1: Knee-flexor force (pain, n=8). The red regions indicate significant differences in group means ($p<0.05$).

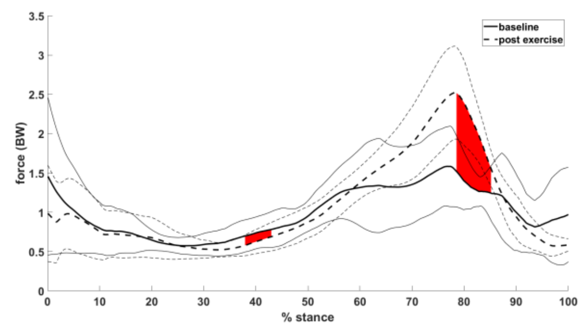

Figure 2: Knee-flexor force (no-pain, n=4). The red regions indicate significant differences in group means ($p<0.05$).

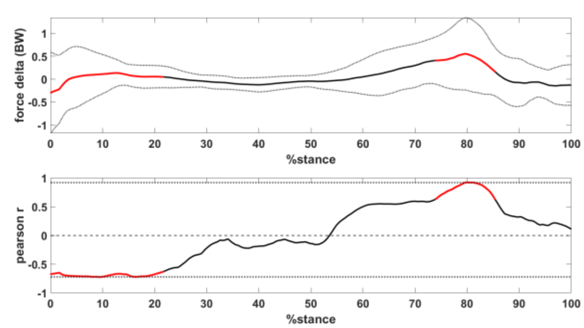

Figure 3: Correlation of absolute claudication distance difference and knee flexor force difference (n=12). The red regions indicate significant correlations ($p<0.05$).