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The Effects of a 6-Week Intrinsic Foot Muscle Exercise Intervention on Foot Morphology, Kinematics, and Kinetics in Individuals with Pes Planus

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CONTEXT

The intrinsic foot muscles are vital in supporting the medial longitudinal arch of the foot. Individuals with pes planus have poor foot morphology, strength, and biomechanics, warranting an intervention.

OBJECTIVE

To determine the effects of a 6-week intrinsic foot muscle strengthening intervention on foot morphology and biomechanics in individuals with pes planus.

DESIGN

Randomized controlled trial.

SETTING

University research laboratory.

PARTICIPANTS

Fifteen healthy subjects (8 males, 7 females, 22.93±4.30 yrs, 172.07±8.50 cm, 80.40±21.09 kg) from a university setting were recruited to participate in the study. Using random block sampling, 8 individuals were allocated to the intervention group and 7 were allocated to the control group.

INTERVENTION

The 6-week intrinsic foot muscle intervention consisted of the following strengthening exercises: short-foot, isolated great toe extension, isolated second-fifth toe extension, and toes-spread-out. Two sets of fifteen repetitions of each of the four exercises were performed on each foot during each session throughout the intervention period. Each repetition was maintained for a five-second isometric hold. Exercises were progressed in

difficulty over the course of the 6-week intervention. Participants were asked to complete the exercise intervention four times a week for the duration of the study. Individuals in the control group did not undergo any form of intervention.

MAIN OUTCOME MEASURES

At pre-intervention, foot posture and arch height were assessed via the Foot Posture Index-6 and the Navicular Drop test, respectively. Cross-sectional area of the abductor hallucis was assessed using ultrasound as an indirect measure of strength. Biomechanical measures, including peak rearfoot eversion, peak tibial internal rotation, peak rearfoot eversion moment, and center of pressure excursion, were collected using 3D-motion capture and an instrumented treadmill. At post-intervention, these morphological and biomechanical measures were repeated. Descriptive statistics were calculated for each dependent variable by group and time. A repeated measures ANOVA was conducted for each dependent variable with the within subjects factor time and between subjects factor group.

RESULTS

There was a significant interaction of time by group for peak tibial internal rotation ($F_{1,13}=13.31$, $p=0.003$, $\eta=0.51$, $1-\beta=0.92$). No other variables had a significant interaction or main effect ($p>0.05$). For the control group there was no significant change in peak tibial internal rotation across time ($p=0.08$). For the intervention group there was a significant

change in peak tibial internal rotation across time ($p=0.006$). Individuals in the intervention group experienced an average decrease in peak tibial internal rotation of $6.13\pm 1.86^\circ$ with a large effect ($g=0.87$).

CONCLUSION

A 6-week intrinsic foot muscle exercise intervention reduced peak tibial internal rotation in individuals with pes planus.

KEY WORDS: *biomechanics, foot posture*