# The Effect of an Intrinsic Foot Muscle Strengthening Device on Postural Steadiness and Pain Management in Individuals with Foot Pain

**Yale B. Hughes**, Ashlyn M. Jendro, Avery G. Dilley, Abigail C. Schmitt
The MOVE Lab, Exercise Science Research Center, University of Arkansas, Fayetteville AR, USA
Email: movelab@uark.edu

## Summary

Using the FootCore Max device 4 minutes per day for intrinsic foot muscle strengthening can improve self-reported foot pain outcomes after 6 weeks of training. However, single-leg balance measures did not significantly improve.

## Introduction

Intrinsic foot muscles (IFM), the small muscles of the foot, are important in maintaining the structure of the arch [1] and postural balance, with increased activity during single leg tasks [2]. When these muscles are weak, myriad foot pathologies can occur which can lead to foot pain or disability [1]. Strengthening the IFM is possible through short foot exercises (SFE) [1,2,3], and SFE have shown to improve single-leg balance tasks [4]. The FootCore MAX was designed to strengthen the IFM with a suggested use of 4 minutes per day.

The purpose of this study was to test the efficacy of the FootCore MAX training device for improving pain levels and single-leg balance measures from individuals with foot pathologies. We hypothesize this device will decrease foot pain and improve single-leg balance.

## Methods

Thirteen participants with chronic foot pain (10 female, 25.4 ± 4.3 yrs, 1.65 ± 0.08 m, 73.0 ± 17.6 kg) performed 6 weeks of at-home SFE using the FootCore MAX foot training device.

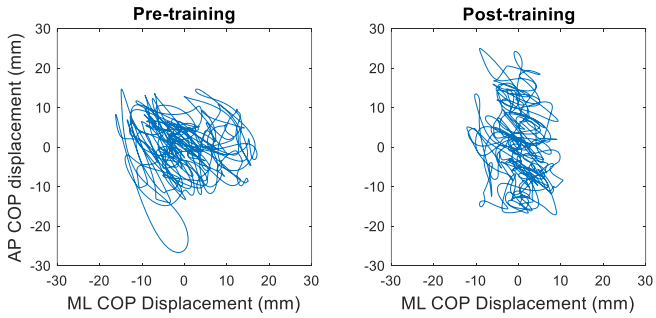
Laboratory visits pre- and post- training were used to evaluate foot pain, function, and balance. Questionnaires included the Foot and Ankle Outcome Score (FAOS), the Foot and Ankle Disability Index (FADI), and a visual analog scale (VAS) for pain. Single-leg static balance was assessed twice for each limb using a force plate (AMTI, 1000 Hz) for 30 seconds each. VAS pain was assessed before and after both pre- and post-training sessions. Center of pressure (COP) data was downsampled (100 Hz) and used to compute root mean square distance (RMS) in the anteroposterior (AP) and mediolateral (ML) directions, COP mean velocity in the AP and ML directions, and sway area. Paired samples t-tests compared pre- and post- pain and balance measures (RStudio v 4.4.2).

## Results and Discussion

No significant differences were detected pre- to post-training for COP-based measures of single leg balance ($p > .05$, Table 1), suggesting the FootCore MAX did not elicit meaningful improvements in single-leg balance.

In contrast, pain subscores from both the FAOS ($p = .04$) and FADI ($p = .03$) revealed participants reported significantly less foot pain post-training. The VAS pain did not show a significant effect of training before testing ($p = .52$) or after testing ($p = .05$), although mean VAS pain scores after balance testing were lower in the post-training session (16 ± 18) compared to the pre-training session (27 ± 14).

**Figure 1**: Representative COP trajectories from one subject: pre- and post-training single-leg balance.




## Conclusions

Although single-leg balance did not improve after 6 weeks of training with FootCore MAX, self-reported measures of foot pain did improve, suggesting some benefit of use.

## Acknowledgments

The study was funded by a Research and Innovation Grant, an Arkansas Technology Transfer Grant, and the Honors College

## References

[1] Jaffri AH et al. (2023). *J of Athl Train,* **58**: 941-951.
[2] Kelly LA et al. (2012). *Clin Biomech,* **27** : 46-51.
[3] McKeon PO et al. (2015). *Br J Sports Med,* **49** : 290-299.
[4] Lynn SK et al. (2012). *J of Sport Rehab,* **21** : 327-333.

**Table 1:** Means and standard deviations of single-leg balance measures and pain subscores. Pre- post- significance ($p < .05$) in **bold**.

| | RMS AP (mm) | RMS ML (mm) | Velocity AP (mm/s) | Velocity ML (mm/s) | Sway Area ($mm^2/s$) | FAOS pain subscore | FADI pain subscore | VAS pre-testing | VAS after testing |
|---|---|---|---|---|---|---|---|---|---|
| Pre-training | 9 ± 2 | 9 ± 5 | 24 ± 4 | 25 ± 5 | 158 ± 75 | **37 ± 18** | **4 ± 4** | 12 ± 11 | 27 ± 14 |
| Post-training | 8 ± 1 | 8 ± 4 | 21 ± 3 | 23 ± 5 | 125 ± 47 | **26 ± 15** | **3 ± 3** | 14 ± 13 | 16 ± 18 |