Reliability of a New Foot Arch Muscle Performance Test

[1]**Benjamin Kytta DPT '24, CSCS,** [2]Karli Epstein, DPM '26, [1]Shane McClinton PT, DPT, PhD, OCS, FAAOMPT, CSCS
[1]Department of Physical Therapy, Des Moines University, Des Moines, Iowa
[2]College of Podiatric Medicine and Surgery, Des Moines University, Des Moines, Iowa

Background

- Foot arch weakness is associated with pain, gait abnormalities, and balance deficits[1-3].
- Measurment of arch strength is relevant for clinical management of these conditions.
- There is currently no standardized means to quantify foot arch strength.
- This study evaluated the reliability of a novel foot arch muscle performance test.

Methods

- Testing involved raising of the foot's arch while maintaining fore- and midfoot contact.
- A handheld dynamometer was fixed to the top of foot's arch, near the navicular, and measured peak force.
- Testing was completed on 2 separate days by a single investigator blinded to results.
- Average peak force of 3 trials was used in statistical analysis.

Results

Population (n)	Healthy Adults (11)
Peak Force (SD)	17.2 (10.3) lbs.
Interclass Correlation Coefficient (ICC)	0.881
95% Confidence Interval (95% CI)	0.585-0.967
Standard Error of Measurment (SEM)	3.56 lbs.
Minimal Detectable Difference (MDD)	9.87 lbs.

Muscles Contributing to Foot Arch

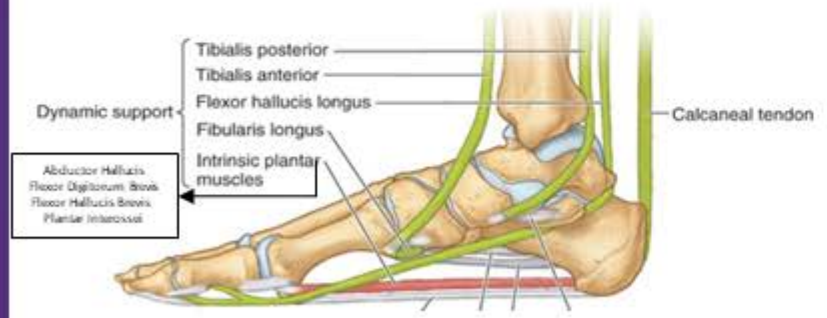

Fig .1 - Muscles contributing to the foot's arch include those that elevate the arch (tibialis anterior, tibialis posterior, flexor hallucis longus, intrinsic planar muscles), and those that aid in foot stabilization (fibularis longus, calcaneal tendon). The arch elevators were tested in this study.

Testing Procedure

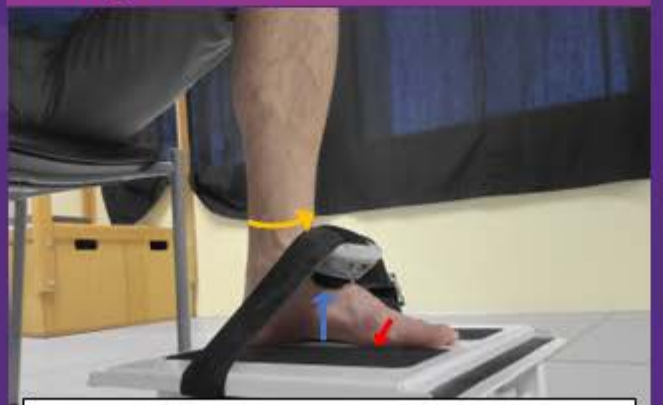

Fig 2. - The testing procedure required pushing of the foot's arch into a fixed dynamometer. This motion is achieved through tibial external rotation (orange), arch elevation at the navicular (blue),and maintenance of forefoot contact at the metatarsophalangeal joint. (red).

Conclusion

- Test-retest reliability is HIGH (ICC=0.881)
- Differences less than 3.6 lbs can be attributed to error.
- The minimal detectable difference (MDD) is 9.9 lbs, but further testing is required to establish the minimal clinically important difference (MCID).
- This test is a reliable and clinically useful means to track foot arch strength for those with arch weakness and associated functional impairments.

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1.Neal BS, Griffiths IB, Dowling GJ, et al. Foot posture as a risk factor for lower limb overuse injury: a systematic review and meta-analysis. J Foot Ankle Res. 2014;7(1):55. Published 2014 Dec 19.

2.Zhang X, Pauel R, Deschamps K, Jonkers I, Vanwanseele B. Differences in foot muscle morphology and foot kinematics between symptomatic and asymptomatic pronated feet. *Scand J Med Sci Sports*. 2019;29(11):1766-1773.

3.Zuil-Escobar JC, Martínez-Cepa CB, Martín-Urrialde JA, Gómez-Conesa A. Prevalence of myofascial trigger points and diagnostic criteria of different muscles in function of the medial longitudinal arch. Arch Phys Med Rehabil. 2015;96(6):1123-1130.