

2016 Research Week Proposal

Title: The Transverse Arch Index: A Novel Method of Determining Arch Type from Footprints and the Impact of Footwear on Arch Height

Program of Study: Biomedical Sciences

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Abstract: A novel index (the *transverse arch index*; *TAI*) is presented for rapidly distinguishing foot arch types from static footprints. Unlike several other footprint-based arch typing schemes, obtaining the TAI does not require measuring curved lines or areas under a curve and is independent of extraneous footprint parameters, e.g., the width of the forefoot or the lateral edge of the foot. Consequently, the TAI is rapid to obtain and easy to calculate while providing highly reproducible results ($\pm 5\%$ of median values). Though the TAI takes advantage of the transverse arch, it is used as a determination of medial longitudinal arch (MLA) height. Although the TAI can easily distinguish between the traditional three MLA arch types (pes cavus, pes rectus and pes planus), the high resolution and reproducibility of the TAI make it possible to distinguish six arch types from flat to high. Flatfoot is epidemic in the United States and throughout the Western world, affecting perhaps 25% of the population. It is well known that footwear impacts the biomechanics of ambulation and the anatomy of the feet, and it has been suggested that arch supports, whether integral to footwear or added as an orthotic, may actually weaken the arches and cause them to fall. Here, we present a case study in which the arches of a male subject with flat feet were monitored using the TAI over four years as the subject adopted a barefoot lifestyle. His arches rose substantially from a low pes planus (TAI 1.73) to normal pes rectus (TAI 0.92)

as a result of barefoot walking and running and avoiding any form of arch support. Finally, the height of the navicular bone is sometimes used as a quick and easy estimation of foot arch height; however, no correlation between TAI and navicular bone height was observed, suggesting that navicular bone height may not be a reliable method of estimating arch height.

Christian worldview integration: *“Take off your sandals, for the place where you are standing is holy ground.” Exodus 3:5.* Leonardo Da Vinci said the human foot was a masterpiece of engineering and a work of art. As Christians, we agree with Da Vinci’s assessment and recognize God as both the artist and engineer of our feet. The feet are highly dynamic structures that together possess 25% of our body’s bones and sixty muscles to achieve standing, walking, running, and jumping with little thought or reward. The arches of the feet are uniquely human, as is upright, bipedal locomotion. At least in this regard, our feet are surely part of what make us image-bearers of God. As dynamic structures, the arches of the feet lengthen, shorten, flatten, and rise with every step. They distribute body weight across the foot when standing and coordinate the complex flow of body weight through our feet from heel to toe when walking. With each step, our foot arches engage the Windlass mechanism to convert the foot from a supple landing platform to a rigid propulsion lever. Yet because of our cultural attachment to footwear, our feet suffer needless abuse. Flat feet and fallen arches are at epidemic proportions in the United States and throughout the Western world. It has been suggested that arch supports, although utilized to treat flat feet and alleviate the pain of fallen arches, may in fact be a cause of these conditions. Although shoes are useful tools and there are times when it’s prudent to wear them, the overuse of poorly design shoes should be avoided and more barefoot activities encouraged – rather than discouraged – by podiatrists, parents, and other authority figures to improve the health of our feet.