Arch Height and Injury:
Is There Really No Connection?

By Tom Michaud, DC

The belief that people with low arches are more prone to injury dates back to the late 19th century, when the surgeon Royal Whitman first described the "pathological flatfoot," which he correlated with pain, excessive pronation, and difficulties walking. Over the past 100 years, there have been numerous articles confirming Whitman's early research showing that people with low arches have poor balance, impaired athletic performance, and are more likely to fall as they get older (1-4). Importantly, it's not just people with low arches who are injury prone as research shows that high-arched people are more likely to have rigid feet and are predisposed to high-impact injuries, such as stress fractures and lateral ankle sprains (5,6).

Despite numerous papers showing a strong clinical connection between arch height and injury, several studies have questioned the connection. In their 2023 editorial published in the *British Journal of Sports Medicine,* Moisan et al. state "flat feet should be considered as healthy anatomical variants" and that the connection between arch height and injury is an "outdated" notion that needs to be abandoned (7).

Flawed Research Showing Arch Height Is Not Connected to Injury

In the most frequently referenced paper questioning the clinical significance of arch height, Messier et al. (8) performed a two-year prospective study on 300 runners and determined that contrary to long-held beliefs, arch height was in no way correlated with an increased risk of injury. Unfortunately, the authors of this study used footprint measurements as a surrogate measure of arch height, which has been proven to be invalid predictors of arch height. Several studies have shown that footprint measurements do not correlate with x-ray measurements of arch height (9) and are prone to error as people with high BMI and/or muscular feet can be incorrectly classified as having low arches even when they have neutral arches (10). Obviously, classifying someone with a neutral foot as low-arched individual would make it impossible to correctly identify injury risk associated with arch height.

In another frequently referenced paper suggesting that arch height is not correlated with injury, Nielsen et al. (11) used the Foot Posture Index to categorize 927 novice runners as having one of 5 foot types: extremely low arches, slightly low arches, neutral arches, slightly high arches, or extremely high arches. Once classified, runners began a 12-month running program while being

monitored for injuries. At the end of the study, the authors found no correlation between arch height and injury, except for the unexpected finding that people with slightly low arches were less likely to get injured than people with neutral arches. Although this paper has been cited over 200 times as proof that there is no correlation between arch height and injury, the authors fail to emphasize they found a robust connection between extremely low arches and injury, as every runner possessing this foot type was injured almost immediately. In fact, not one of the athletes with extremely low arches was able to complete the one-year training program. The authors claim they did not emphasize the high injury rate in this population because only 2% of the runners in their study presented with extremely flat feet, so the sample size was too small to make adequate conclusions. Apparently, because the authors did not allow people to participate who had previously worn orthotics, the extremely low-arched group was statistically underpowered making it impossible to draw accurate conclusions about the effect of extremely low arches on injuries.

Research Showing Arch Height Is Connected to Injury

In 2019, researchers from Spain repeated the Nielsen study, this time including a sample population of 600 novice runners in which 11.2% possessed extremely pronated foot postures (12). Using the same Foot Posture Index to identify foot architecture used in the Nielsen study, Pérez-Morcillo et al. (12) performed a logistic regression model to evaluate the correlation between arch height and injury. Using this detailed model, these authors prove there is a powerful connection between arch height and injury: runners with extremely low arches were 20 times more likely to be injured than people with neutral foot postures, and runners with extremely high arches were 76.8 times more likely to be injured. The authors of this study also point out that in contrast to Nielsen et al. (11), slightly low and slightly high arches were also associated with an increased risk of running injuries compared to a neutral foot.

The Overlooked Importance of Foot Strength

Though rarely discussed, a major problem with all of the research evaluating the correlation between arch height and injury is that none of them take into consideration the protective effect of foot strength. This is unfortunate as a growing body of research is showing that even if you have extremely low arches, you are significantly less likely to be injured if your feet are strong. This was clearly demonstrated in 2019, when Zhang et al. (13) used ultrasonography to show that people with painful flat feet had considerably smaller abductor hallicus, flexor digitorum longus, and peroneal muscles than people with low arches who were pain-free. In 2025, Haelewijn et al. (14) evaluated three-dimensional motion and muscle volume in people with symptomatic and asymptomatic flat feet and determined that flexor digitorum longus and

quadratus plantae were considerably thinner in people with symptomatic flat feet (Fig. 1). The authors state "our findings support a shift from structural assessment towards performance-based clinical evaluations." Note that weakness of the flexor digitorum longus is easily evaluated using a toe strength dynamometer, which has excellent interrater reliability (15).

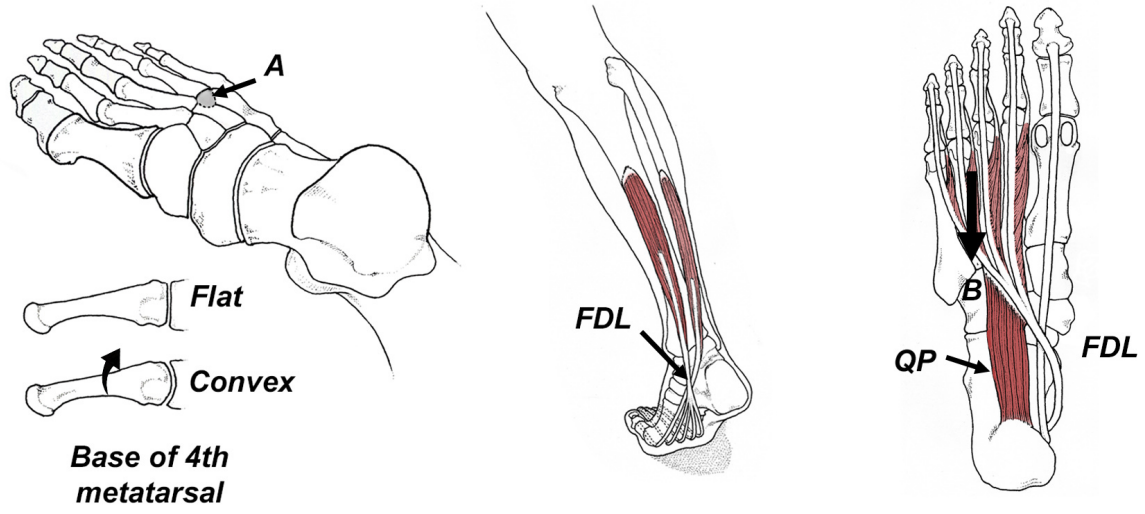

Fig. 1. The Flexor digitorum longus (FDL) and quadratus plantae muscles (QP) are considerably thinner in people with symptomatic flat feet. These muscles are important in stabilizing the arch in people with flat feet because recent research shows that unlike people with neutral arches, people with low arches tend to have a convex base to their fourth metatarsal (**A**), which allows the midfoot to collapse as the outer metatarsals move upwardly during propulsion (**curved arrow**) (21). To prevent this upward motion, FDL creates a compressive force along the lateral metatarsals (**B**) that prevents the midfoot from collapsing during propulsion. According to Dygut et al. (22), FDL is the only muscle capable of stabilizing the fourth and fifth metatarsals.

Foot Strengthening Prevents Injury and Improves Performance

Given the recent research showing a connection between foot strength and weakness, low-arched individuals with weak feet should begin an aggressive foot strengthening program. A study out of Temple University found the ToePro exercise platform produced a 25% increase in flexor digitorum longus strength in just 6 weeks, which correlated with a measurable improvement in functional tasks, such as the anterior reach test (16). Another study out of Brazil showed that simple foot strengthening exercises performed for just eight weeks resulted in a 240% decreased rate of running injuries over the following 12 months (17). Foot strengthening exercises are particularly advantageous for individuals with low arches. Sulowska et al. (18) demonstrated that, in comparison to those with neutral arches, people with low arches experience more

significant improvements in running speed and power following structured foot strengthening interventions. Strengthening should also be considered for individuals with high arches, as they often present with weakness in the peroneal muscles that can easily be addressed with specific exercises. While conventional treatment strategies for people with high and low arches have often focused primarily on the use of orthotics, several studies have shown that you get the best clinical results when you couple orthotics with foot exercises (19,20). Foot strengthening exercises are inexpensive, easy to perform, and result in significantly better outcomes.

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