

HIDDEN IN PLAIN SIGHT: Ordinary Elevated Shoe Heels Have Deformed The Entire Modern Human Body

Elevated shoe heels plantarflex a wearer's ankle joint. Based on the work of Hicks and many other researchers, plantarflexion supinates the subtalar joint. Although it follows directly that footwear heels must supinate the subtalar joint, the probable effects of that artificial coupling on ankle joint external rotation and calcaneal inversion have never been explored.

A probable direct effect on the structure of the human foot was published in 1939 in *The Lancet*: footprints are the same between individuals who have never worn shoes despite significantly different genetic backgrounds (**FIGURE 1A**).

In comparison, a modern human foot exposed to everyday use of modern shoes with elevated heels is externally rotated about 6° into a **supination** position (**FIGURE 1B**).

A 1931 study in the *American Journal of Physical Anthropology* indicated that the modern European calcaneus (**D**) is inverted about 6° compared to those of two genetically different barefoot populations (**B & C**) (**FIGURE 1C**).

That 6° result is supported by unpublished data from a 2015 ISB prize-winning biomechanical study by **Steffen Willwacher et al.** of 222 male and female runners indicating that his test subjects had **4° to 5° of ankle inversion** while standing in their own running shoes and also by various earlier studies by **Peter Cavanagh, Joe Hamill, and Steven Subonick**.

Biomechanically, that **4 to 6°** level of modern ankle inversion and lower leg inversion is inherently unstable without a medial heel wedge (**FIGURE 1D**) and directly results in compensating **ankle eversion** during locomotion, as noted by **Cavanagh**. Eversion is unknown in habitually barefoot populations.

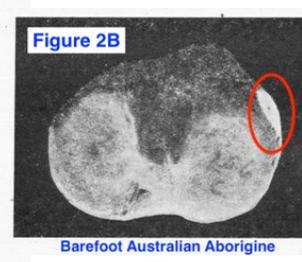
In addition, my analysis of published data from the **Willwacher et al.** study has produced new experimental confirmation of that artificial foot supination: despite an observed ankle eversion of about **8°**, an average of about **shoe sole-induced 6° foot supination position (with 10° tibial external rotation)** apparently persists during midstance, causing an observed **10°** reduction in the expected tibial internal rotation. That reduction accounts for an

otherwise unexplained **decoupling** of calcaneal/tibial motion.

The artificial foot supination during running should have other effects on the body, since shoe heel-induced plantarflexion is present throughout midstance during a running peak load of 2-3 times bodyweight.

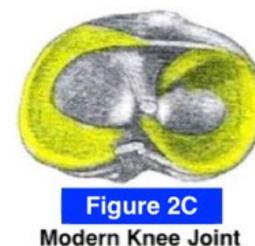
The **6°** supinated modern foot externally rotates the ankle joint and tibia to the outside about **10°**, creating an abnormal rotary torsion – well-known as the unexplained “screw-home mechanism” – that is built into the bone structure of the modern knee joint of an exemplary habitually **shod Modern European** (**FIGURE 2A**). It gradually enlarges and weakens one or both knees, promoting osteoarthritis and ACL injuries.

In contrast, the rarely injured natural barefoot knee (**FIGURE 2B**) of an exemplary non-shoe wearer, a barefoot **Australian Aborigine** (as well as Caucasians from India and ancient Rome), has a smaller, simpler structure, with no abnormal built-in rotary motion and with stronger, more secure ligament attachments, such as for the iliotibial tract (circled in **red**).



The modern knee's asymmetrically twisted and malformed **menisci** highlight its apparent abnormality, the medial meniscus being pushed far forward relative to the lateral meniscus (**FIGURE 2C**).

In evolutionary terms, it is already well-established that the human body was born to run. In terms of evolution-in-reverse, an artificial transformation of the modern human body from natural to deformed occurs during running with supination-inducing modern shoes.



That is because, during running, the highest repetitive forces on the human body are experienced. That pounding repetitive load of 2-3 times bodyweight controls bone growth and joint formation during the critical growth phases of childhood and adolescence, when running is frequent, in accordance with Wolff's Law and Davis's Law governing bone and joint development.

During locomotion, especially running, the supinated modern foot automatically twists and tilts the modern body's entire skeletal structure into a bilaterally asymmetrical position, including both legs, as well as the pelvis, and everything supported it, including the spine, torso, arms, and skull.

This prototypical modern human body is unlike an exemplary **African Bushman (FIGURE 3A)** who, having grown up barefoot, has natural body structure when running at peak load in midstance: symmetrical with straight legs and level pelvis, with no leg crossover and well-defined spine, as well as no apparent foot supination or pronation. Evidence indicates that Asians and Caucasians who have not worn modern shoes, such as young Kim Phuc and Zola Budd, have the same vertically aligned body structure.

In contrast, the exemplary modern body of the **shod Finnish marathoner (FIGURE 3B)**, having grown up with modern shoes and supinated feet, is tilted and twisted away from a vertical centerline. He has a twisted pelvis and bent-out thoracic spine with shallow definition and unnatural torsion abnormally distorting

Research Note:

I should also include here a note about the extent of my research effort. I have conducted over a period of many years a comprehensive analysis of all the peer-reviewed research I could find in many different disciplines like biomechanics, anatomy, orthopedics, podiatry, physical anthropology, archeology, and various others that were related to shoe heel-induced supination, including many articles available only at the Library of Congress and the National Library of Medicine, not online. The **Endnotes** of my unabridged book now totals over 73 pages, mostly listing the many peer-reviewed articles I reviewed and concluded were relevant, and specifically noting the exact pages and/or specific figures that were considered most relevant. Far more articles were reviewed and deemed not sufficiently relevant to include.

LIST OF FIGURES

Introductory Figure **Figure 10.183** from *Sarrafian's Anatomy of the Foot and Ankle*, Third Edition. Armen S. Kelikian, Ed. (2011), Lippincott Williams & Wilkins. Adapted from Hicks, J. H. (1961) The three weight-bearing mechanisms of the foot. In: Evans, F. G. ed. *Biomechanical Studies of the Musculo-Skeletal System*. Springfield, IL: Charles C. Thomas.

Figure 1A & 1B Different bare footprints of shoe-wearing European and barefoot Solomon Island native from **James**, Clifford S. (1939). Footprints and feet of natives of the Solomon Islands. In *The Lancet*: 2: 1390-1393.

Figure 1C Lawrence H. Wells (1931). The Foot of the South African Native. In the *American Journal of Physical Anthropology*, Vol. XV, No. 2. 186-289, **Figure 6** on **page 225**.

Figure 1D Adapted from **Figure 8.5** of *The Running Shoe Book* by Peter R. Cavanagh (1980).

Figures 2A & 2B Comparative views of the European and Australian Aborigine tibial plateaus (lower surface of the knee joint) from W. Quarry Wood (1920). The Tibia of the Australian Aborigine. In the *Journal of Anatomy* Vol. LIV: Parts II & III (January and April): 232-257, **Figure 1** on **page 235**.

Figure 2C A typical modern tibial plateau of right knee showing asymmetrical and malformed meniscus cartilage on the left, forward of the knee, based on **Figure 349** of the *1918 Edition of Gray's Anatomy*.

Figures 3 A&B A cropped rear view still photo frame of a Bushman (A) and Shod Finn (B) from a **YouTube** video clip of Barefoot running Bushman versus me (shod Finn) <https://www.youtube.com/watch?v=H1Ej2Qxv0W8>. Published on May 26, 2013.

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