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SHOE HEELS CAUSE THE SUBTALAR JOINT TO SUPINATE, INVERTING THE CALCANEUS AND ANKLE JOINT

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INTRODUCTION

The observable effect of the elevated heel of a shoe is to place the ankle joint of the wearer's foot into a plantar-flexed position. Plantar-flexion supinates the subtalar joint, an effect that is a well-known bio-mechanism crucial to toe-off propulsion, as investigated in detail by many past and present researchers (Hicks, 1961) (Root, Weed, Sgarlato, & Bluth, 1966).

It is therefore biomechanically logical that the shoe heel, by causing plantar flexion, also automatically causes the wearer's subtalar joint to supinate, albeit an effect far less obvious. That subtlety may account for the lack of research on the coupling of elevated shoe heels with subtalar joint supination.

Such supination would be expected to invert and abduct the calcaneus, placing the ankle and foot into an artificially unstable position.

PURPOSE OF THE STUDY

The purpose is to determine if scientifically valid evidence supports the logical conclusion that the **elevated shoe heel causes the subtalar joint to supinate, inverting the ankle joint.**

METHODS

A search was conducted for evidence of an inverted ankle or foot position in relevant scientific literature on shod populations and, despite scant data, on barefoot populations.

RESULTS

A study found that the bare footprint from a habitually shod European population is noticeably offset to the outside – indicative of subtalar supination and ankle inversion and abduction – as compared to the footprint from a never shod Polynesian population (James, 1939), as illustrated in **Figure 1**.

Notably, the footprint of a never shod European foot is virtually identical to the footprint of a traditionally barefoot Polynesian.

Another study includes a figure showing that the habitually shod European calcaneus is inverted when compared to the calcanei from two different habitually barefoot African tribes, Bushman and Bantu (Wells, 1931), as illustrated in **Figure 2**.

The extremely pronounced lateral calcaneal tuberosity in the European, almost nonexistent in the Africans, suggests it may be produced by the artificial inversion of the shod calcaneus.

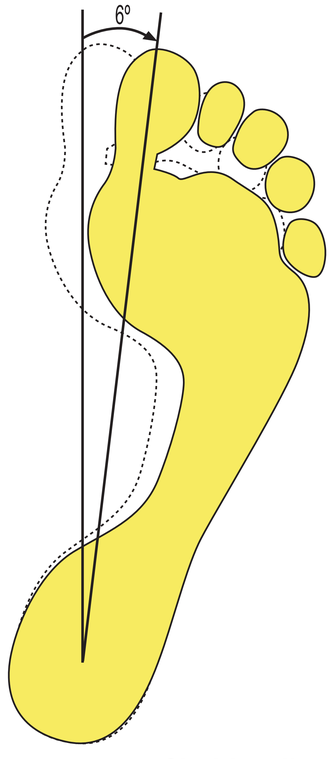

Figure 1. Foot of habitually shod European is supinated about 6° compared to never shod European (and Polynesian).

A study of 222 habitually shod runners includes unpublished data indicating that, while standing in their own running shoes, they have an average of 4° of ankle inversion for 129 males and 5° of ankle inversion for 93 females (Willwacher et al., 2016).

The result of 4° of male standing inversion is essentially the same as the 4° of varus used by Steven Subotnick, who in 1976 convinced the Brooks Shoe Company to use a 4° varus heel wedge in its top-rated Vantage running shoe – a concept still used today.

A shoe's varus wedge is well understood to artificially put the subtalar joint into a neutral position so that the calcaneus is aligned with the talus and tibia.

Without the varus wedge, the subtalar joint is forced to pronate 4° in order for the calcaneus to become level, aligning itself with the level surface below it. The subtalar joint of the shod modern runner is thereby put in an inherently unstable position, artificially prone to excessive subtalar pronation and excessive ankle eversion.

In contrast, it has been observed that "…of the Bantu [the principal tribe of South Africa] … in running … **there is no eversion**, but the foot sinks down, as it were, 'on an even keel,' in consequence of a flattening of the lateral arch…" (Wells, 1931) [bolding added].

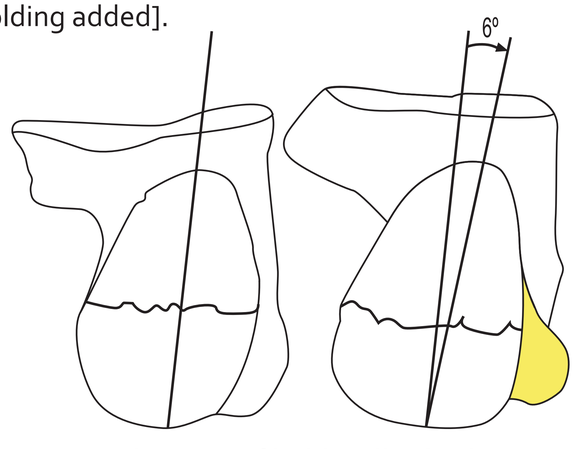

Figure 2. Calcaneus of habitually shod European is inverted 6° compared to never shod Africans and has enlarged lateral tuberosity.

DISCUSSION AND CONCLUSION

These limited findings indicate that important anatomical differences between the modern shod population and barefoot populations are the probable effect of habitual modern shoe use, not genetics.

New and far more comprehensive studies including measurement of ankle inversion and abduction are needed to compare barefoot populations with genetically identical shod populations, particularly when running barefoot and shod, with and without elevated shoe heels.

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