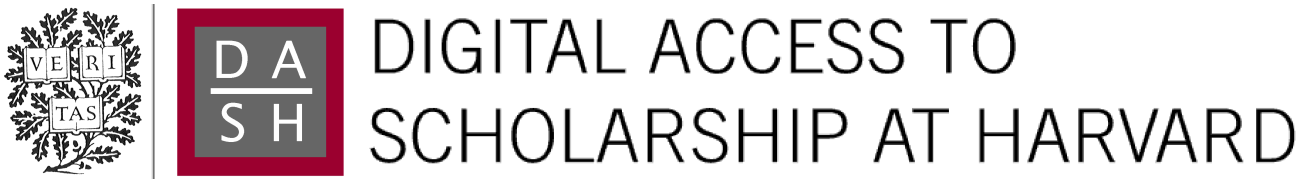

Why are our toes so tiny? Walking, running and the evolution of a short forefoot in the genus Homo

Why are our toes so tiny? Walking, running and the evolution of a short forefoot in the genus Homo

Rolian Campbell, Daniel E. Lieberman, John W. Scott

Abstract:
Humans have an extremely short forefoot relative to total foot length. The derived pedal proportions of humans are thought to have evolved in the context of committed bipedalism, but the benefits of shorter toes for walking and/or running have not previously been tested. Short toes are typically associated with cursorial digitigrade mammals, where they improve the ability of the digital flexor apparatus – the muscles, tendons and ligaments that collectively flex and resist extensions of the metatarsophalangeal (MTP) joints – to support the body and generate propulsion at the end of stance. We tested the hypothesis that in humans a shorter forefoot similarly improves locomotor performance by decreasing the force, power and work outputs of the digital flexor apparatus (DFA) during late stance, especially in running, when only one foot provides support and propulsion against high ground reaction forces. Kinematic, force and plantar pressure data were collected from a sample representing normal variation in tow length (n=12). Hindlimb kinematics, DFA force, power and work outputs were compared during barefoot walking and running in subjects with short, average and long forefeet in relation to body mass. Results suggest that individuals with relatively longer forefeet experience higher MPT joint moments, and their DFA generates more force, power and work than subjects with shorter forefeet, at both walking and running speeds. Contrary to our prediction, however, the difference between groups in DFA performance is not greater at running speeds. Implications for the evolution of endurance running in the genus Homo are discussed.