

# Functional Interpretation of the Transverse Arch of the Human Foot

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The fossil record indicates that the emergence of arches in human ancestral feet coincided with a transition from an arboreal to a terrestrial lifestyle. Propulsive forces exerted during walking and running load the foot under bending, which is distinct from those experienced during arboreal locomotion. I will present mathematical models with varying levels of detail to illustrate a simple function of the transverse arch. Just as we curve a dollar bill in the transverse direction to stiffen it while inserting it in a vending machine, the transverse arch of the human foot stiffens it for bending deformations. A fundamental interplay of geometry and mechanics underlies this stiffening --curvature couples the soft out-of-plane bending mode to the stiff in-plane stretching deformation. In addition to presenting a functional interpretation of the transverse arch of the foot, this study also identifies a classification of flat feet based on the skeletal geometry and mechanics.