Foot Functionality Elucidated

When humans walk, our feet act as levers rather than landing pads as previously thought.

By **Rachel Berkowitz**

Running on two legs is more efficient than galloping on four. It can also be sustained for longer, so scientists think our ancestors may have evolved to stride upright, as it provided an advantage over our four-legged prey. Bipedal motion gives humans a unique gait in which the leg swings and the foot acts as a contact to the ground. But, if the foot were simply a landing pad, its structure would likely be much less complex. Now Daniel Renjewski of the Technical University of Munich and his colleagues show that the foot is actually a lever that propels us forward [**1**].

When a human foot contacts the ground, a reactive force travels up into the leg. Measurements of this force show that its magnitude peaks twice per stride. Similarly, the point at which the foot exerts a maximum pressure on the ground changes twice. However, if the foot were simply a landing pad, there should be only one force peak and one point of maximum pressure.

Using previously collected data generated from people walking on a treadmill, the team derived an equation of motion for the foot that ties forces originating above the foot to torques local to the foot. After a person's foot strikes the ground, the upper body pushes down on the leg, increasing the torque on the ankle and shifting weight toward the toes. This weight shift causes the person's body to move forward; the foot remains firmly planted.

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The strike of the person's foot and the subsequent shift of weight induce two separate pressure peaks on the ground, as expected for models that treat the foot as a lever. Renjewski and colleagues say that their model could help improve designs of gait-assistive devices and bioinspired robots.

Rachel Berkowitz is a Corresponding Editor for *Physics Magazine* based in Vancouver, Canada.

REFERENCES

1. D. Renjewski *et al.*, "Foot function enabled by human walking dynamics," **Phys. Rev. E 106, 064405 (2022).**