Study shows shoes change spring-like foot mechanics when people run

15 June 2016, by Bob Yirka

Credit: Paul Brennan/public domain

(Phys.org)—A team of researchers with the University of Queensland's Centre for Sensorimotor Performance has found that running shoes alter the natural spring-like mechanics of the foot while a person is running. In their paper published in the *Journal of the Royal Society Interface*, the group describes experiments they conducted with volunteers running on treadmills, and the differences they observed in foot mechanics when comparing runners running barefoot, versus wearing running shoes.

To avoid gaining weight, many people have taken to jogging, or running as a form of exercise. As running has become more popular, shoe makers have begun selling shoes designed especially for runners, offering both support and protection from injury. But, as the team notes, recent research by other groups has shown that running injury rates have not declined over the past 40 years, causing some to question whether running shoes offer any benefits at all, or if they in fact actually decrease performance.

When running, the longitudinal arch (LA) in the foot serves as a form of spring, bending as we land—the energy in the LA is then expended as we move forward just before lifting our foot for another step, propelling us forward. But, the researchers wondered, do shoes interfere with this spring-like mechanism, and if so, does the foot compensate for it in other ways.

To find out the researchers asked 16 healthy volunteers who were also regular recreational runners, to run on a treadmill multiple times—sometimes while wearing running shoes, other times barefoot. Each of the volunteers was fitted with intramuscular electrodes to record muscle activity in the feet. The running shoes were modified slightly to allow for the electrodes, but not in a way that would interfere with function. The team also used cameras to film the feet in action. The setup allowed for recording kinetic, kinematic and EMG data simultaneously as the volunteers ran.

In studying the data, the researchers found that the running shoes did cause a change in the spring-like mechanism of the foot—there was less compression and recoil—but, they noted also that the body had learned to compensate by building muscle activation. The team was not able to come to a definite conclusion, unfortunately, as to whether people would be better off running with or without shoes, however. They suggest more research will need to be done to find the answer to that question.

More information: Shoes alter the spring-like function of the human foot during running, Published 15 June 2016.DOI: 10.1098/rsif.2016.0174 , http://rsif.royalsocietypublishing.org/content/13/119/20160174

Abstract
The capacity to store and return energy in legs and feet that behave like springs is crucial to human running economy. Recent comparisons of shod and barefoot running have led to suggestions that

modern running shoes may actually impede leg and foot-spring function by reducing the contributions from the leg and foot musculature. Here we examined the effect of running shoes on foot longitudinal arch (LA) motion and activation of the intrinsic foot muscles. Participants ran on a force-instrumented treadmill with and without running shoes. We recorded foot kinematics and muscle activation of the intrinsic foot muscles using intramuscular electromyography. In contrast to previous assertions, we observed an increase in both the peak (flexor digitorum brevis +60%) and total stance muscle activation (flexor digitorum brevis +70% and abductor hallucis +53%) of the intrinsic foot muscles when running with shoes. Increased intrinsic muscle activation corresponded with a reduction in LA compression (?25%). We confirm that running shoes do indeed influence the mechanical function of the foot. However, our findings suggest that these mechanical adjustments are likely to have occurred as a result of increased neuromuscular output, rather than impaired control as previously speculated. We propose a theoretical model for foot–shoe interaction to explain these novel findings.

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