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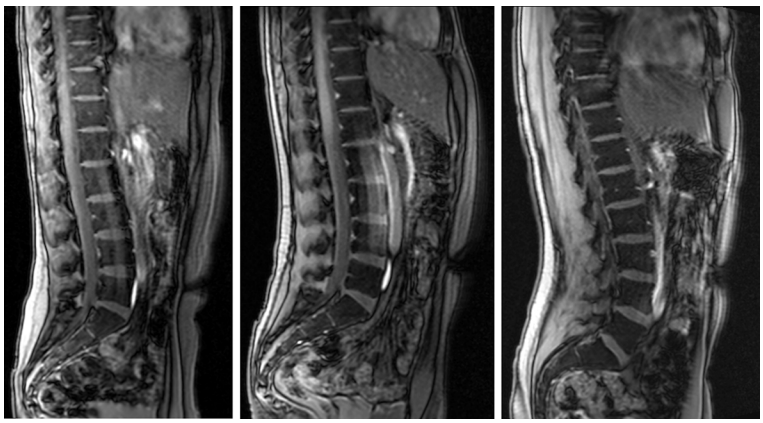
INSIDE JEB

Lower spine curvature is an essential shock absorber for runners



Three MRI scans showing variation in lower spine (lumbar) curvature. Photo credit: The Center for Brain Science Neuroimaging Facility, Harvard University.

Humans aren't the only animals to stride around on two legs – kangaroo rats scurry about on their hindlimbs and lizards often pull a wheelie – but modern humans and our ancestors are the only creatures that have evolved an S-shaped spine to balance our upright weight stably as we stride along. 'What's surprising is that there's a lot of variability in the amount of curvature in the lower spine', says Eric Castillo from Hunter College, USA, describing how runners and soccer players tend to have more curved lumbar spines, while the lower spines of swimmers and even ancient Neanderthals are relatively straight. 'One long-held hypothesis is that a curved lower back helps the lower spine function like a shock absorber', says Castillo, so he and his graduate advisor Daniel Lieberman from Harvard University, USA, began measuring how curvature of the lower spine impacts how well our bodies absorb shocks as we walk and run.

'Without ways to deal with these shocks, we would probably experience a lot more tissue damage and we'd even have trouble keeping our head balanced and seeing straight when running', says Castillo, who selected young adults with a range of builds to run on a treadmill while he filmed their movements and measured the motion of the back at two locations low down on the spine with accelerometers. 'It was tough to work with the accelerometers because they were extremely difficult to solder, wire and attach to people in ways that would give a clear signal', says Castillo. And even after measuring the runners' movements, it wasn't simply a case of directly comparing the acceleration traces. 'Shocks generated during walking and running have different frequency components, which travel differently through the body', says Castillo, so he and Lieberman had first to extract the particular accelerations generated by running impacts before analysing how they diminished as they were transmitted through the body. In addition, the duo measured the curvature of each volunteer's spine ready to begin untangling the effect of the shape of the lower back on shock absorption.

Impressively, the duo discovered that there was a 10% increase in shock absorption as the curvature of the lower spine increased by just 1%; 'That's pretty huge!', exclaims Castillo. And when they built a model of how the cartilaginous discs that cushion the vertebrae contribute to shock absorption, they were surprised to find that they contributed as little as 20%; 'Posture had an even stronger effect on shock attenuation than discs', says Castillo.

Having confirmed that the curvature of the lumbar spine is a crucial shock absorber that protects us from injury while running, Castillo is curious to find out how different tissues, including muscle, ligaments and tendons, dissipate shock energy. He is also fascinated to discover how lumbar spine curvature contributes to shock absorption in other modern human populations. 'The fact that so many of us sit at desks most of the day certainly isn't normal from an evolutionary perspective, so it would be amazing to conduct this kind of experiment in non-Western groups that have very different lifestyles and physical activity patterns', he says. And he suspects that the discovery could explain the differences in spine posture found in human fossils. 'Neanderthals consistently seem to have had really straight lumbar spines compared to us and even earlier fossil species like *Homo erectus* and australopiths', says Castillo, who suggests that Neanderthals may have depended less on running than early humans, possibly relying on their more stable spines to support their heavier body weight or carry heavy loads, such as carcasses for food.

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Kathryn Knight
kathryn.knight@biologists.com