Floppy-footed gibbons help us understand how early humans may have walked

November 17 2008

The human foot is a miracle of evolution. We can keep striding for miles on our well-sprung feet. There is nothing else like them, not even amongst our closest living relatives. According to Evie Vereecke, from the University of Liverpool, the modern human foot first appeared about 1.8 million years ago, but our ape-like ancestors probably took to walking several million years earlier, even though their feet were more 'floppy' and ape like than ours.

Vereecke explains that modern ape feet have a flexible joint midway along the foot (we retain this joint, but have lost the flexibility), which made her wonder how well our predecessors may have walked on two feet. Lacking a time machine, Vereecke and Peter Aerts from the University of Antwerp decided to look at the flexible feet of modern gibbons to find out more about how they walk and publish their work in The *Journal of Experimental Biology* on 14th November 2008 at http://jeb.biologists.org.

But working with gibbons is notoriously hard. 'You can't touch them and you can't work with them in the lab' says Vereecke. Fortunately she and Aerts had access to a troop of the semi-wild apes just down the road at Belgium's Wild Animal Park of Planckendael. Having set up her camera outside the animals' enclosure at foot height, Vereecke simply had to sit and wait for the animals to walk past, hoping that the camera would capture a few footfalls. Eventually after several weeks of patience, Vereecke had enough film footage to begin digitalising the animals' foot movements and build a computer model to find out how they walk.

The first thing that Vereecke noticed was that the animals don't hit the ground with their heels at the start of a stride. They move more like ballerinas, landing on their toes before the heel touches the ground. Analysing the gibbon foot computer model, Vereecke realised that by landing on the toes first they were stretching the toes' tendons and storing energy in them. According to Vereecke, this is quite different from the way that energy is stored in the human foot. She explains that our feet are built like sprung arches spanned by an elastic tendon (aponeurosis) along the sole of the foot. When we put weight on our feet, the arch stretches the aponeurosis, storing elastic energy to power the push off at the end of a stride.

And there were more differences between the gibbon and human walking patterns at the end of a stride. Instead of lifting the foot as one long lever, the gibbon lifted its heel first, effectively bending the foot in two to form an upward-turned arch, stretching the toes' tendons even further and storing more elastic energy ready for release as the foot eventually pushes off.

So what does all this mean for our ape-like ancestors? Vereecke is keen to point out that gibbons are not a perfect model for the ways that early humans may have walked; there are marked differences between modern gibbons and the fossilised remains of early humans. However, modern gibbons live in trees and walk on two flexible feet, just like our ancestors. Her work shows that it is possible to walk quite efficiently with a relatively bendy foot and that our ancestors may have used energy storage mechanisms that are similar to ours, despite their dramatically different foot shapes.

Citation: Vereecke, E. E. and Aerts, P. (2008). The mechanics of the gibbon foot and its potential for elastic energy storage during bipedalism. J. Exp. Biol. 211, 3661-3670.

Source: The Company of Biologists