Elephant legs are much bendier than Shakespeare thought

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Throughout history, elephants have been thought of as 'different'. Shakespeare, and even Aristotle, described them as walking on inflexible column-like legs. And this myth persists even today. Which made John Hutchinson from The Royal Veterinary College, London, want to find out more about elephants and the way they move. Are they really that different from other, more fleet-footed species? Are their legs as rigid and 'columnar' as people had thought? Traveling to Thailand and several UK zoos, Hutchinson and his team investigated how Asian Elephants move their legs as they walk and run and publishes his results in *The Journal of Experimental Biology*.

Striking up collaborations with elephant keepers at Colchester and Whipsnade Zoo, Hutchinson explains that the keepers were keen to know more about the animals' natural limb movements to develop training programmes and prevent the onset of arthritis. Fortunately for Hutchinson, the animals were fantastically cooperative when he turned their exercise enclosure into a film set to record their movements; 'this is the same 3D capture technology used in Hollywood blockbusters,' explains Hutchinson. After the team had stuck hemispheres covered in infrared reflecting tape to joints on the elephants' fore and hind limbs, the animals were happy to walk and run in front of the arc of infrared detecting cameras as Hutchinson and his team filmed their steps at speeds ranging from 0.62 m/s to 4 92m/s. 'The big problem was keeping the markers in place,' says Hutchinson, 'the little ones kept on pulling them off with their trunks.' Having filmed animals ranging in size from 521 to 3512kg, Hutchinson, Lei Ren and Charlotte Miller travelled to

Thailand to film the athletic elite; Thai racing elephants that easily outpaced the UK elephants at 6.8m/s.

Back in the lab, Ren converted each elephant's movements into stick figures, and found that their legs are not as columnar as previously thought, with the shoulder, hip, knee and elbow joints flexing significantly. As the elephants swung their front legs forward they also flicked their feet up, bending their wrists by more than 80°, to keep them clear of the ground. Meanwhile, the elephants' ankles were far more rigid. Unable to bend the ankle as they swung their legs, the animals moved them out in an arc, to avoid dragging their hind feet along the ground. However, it was a different matter when the team analysed their joints during the stance phase; the apparently rigid ankle was relatively spring-like, whilst the previously flexible wrist became rigid while supporting the animal's weight.

Hutchinson also compared his Asian elephant data with Delf Schwerda and Martin Fischer's data from African elephants: the two species were indistinguishable. Most surprisingly, when Heather Paxton investigated the maximum swing range of each joint, she found that elephants were using almost all of their mobility range. And when the team compared the elephants' movements with those of horses, they found that the elephants' joints were almost as mobile as trotting horses'.

Best of all, when Hutchinson compared the athletic Thai elephants with their more sluggish UK cousins, their movements were essentially the same. Captivity had not modified the elephants' mobility range, just slowed them down a little. 'The keepers were very pleased,' says Hutchinson.

So elephant legs are far from the inflexible columns that Shakespeare would have us believe. And Hutchinson adds that as many people base simulations of dinosaur movements on how they think elephants move,

they can now base their simulations on something more realistic.

More information: http://jeb.biologists.org
Source: The Company of Biologists