Shift to shore: New model shows extinct tetrapod Ichthyostega couldn't walk

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A fleshed-out reconstruction of the early tetrapod, Ichthyostega. Image Julia Molnar

Palaeontology has gone high-tech: no more wax and plaster-cast models. Instead, 3D data from computed tomography (CT) scans is overturning long-held views of how the earliest land animals moved.

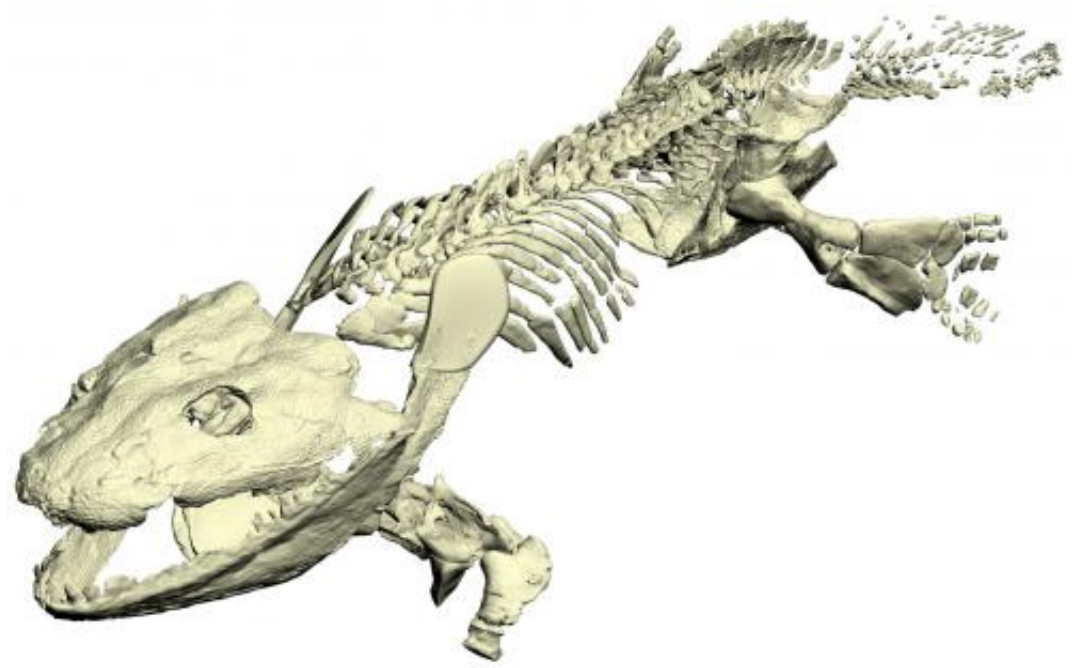
Research published today in *Nature* reveals how a famous extinct animal, the early four-legged vertebrate (tetrapod) called *Ichthyostega*, moved on land 360m years ago.

One major problem in putting together fossil skeletons is actually getting the fossil out of the rock, but now palaeontologists don't have to! Instead, the CT scans allow the virtual preparation of the fossil so delicate bones can be fully isolated and then fitted together so the anatomy can be better understood.

It was this process that has allowed scientists (Stephanie E. Pierce and Professor John R. Hutchinson from the UK's Royal Veterinary College and Professor Jennifer A. Clack from the University of Cambridge) to overturn long held assumptions on how one of the earliest tetrapods moved from the water on to land.

Ichthyostega was first discovered in East Greenland in 1932 and is mostly figured as the first four-legged fish. But this new work shows that Ichthyostega could not walk using all four limbs because the limbs were not able to rotate in a manner that would allow terrestrial locomotion.

Instead Ichthyostega used the front limbs to haul itself along the surface.



A 3D skeletal reconstruction of Ichthyostega. Image: Stephanie Pierce

The next step is to achieve what many palaeontologists dream of – to reconstruct the soft anatomy. This study shows how the latest imaging technology combined with a strong knowledge in comparative anatomy can enhance our understanding of how these ancient animals moved.

Importantly, the new work provides a clearer picture of how our early ancestors made it out of the aquatic environment and on to land.

More information: Three-dimensional limb joint mobility in the early tetrapod Ichthyostega, *Nature* (2012) doi:10.1038/nature11124

Abstract
The origin of tetrapods and the transition from swimming to walking was a pivotal step in the evolution and diversification of terrestrial

vertebrates. During this time, modifications of the limbs—particularly the specialization of joints and the structures that guide their motions—fundamentally changed the ways in which early tetrapods could move1, 2, 3, 4. Nonetheless, little is known about the functional consequences of limb anatomy in early tetrapods and how that anatomy influenced locomotion capabilities at this very critical stage in vertebrate evolution. Here we present a three-dimensional reconstruction of the iconic Devonian tetrapod Ichthyostega and a quantitative and comparative analysis of limb mobility in this early tetrapod. We show that Ichthyostega could not have employed typical tetrapod locomotory behaviours, such as lateral sequence walking. In particular, it lacked the necessary rotary motions in its limbs to push the body off the ground and move the limbs in an alternating sequence. Given that long-axis rotation was present in the fins of tetrapodomorph fishes5, 6, 7, it seems that either early tetrapods evolved through an initial stage of restricted shoulder8, 9 and hip joint mobility or that Ichthyostega was unique in this respect. We conclude that early tetrapods with the skeletal morphology and limb mobility of Ichthyostega were unlikely to have made some of the recently described Middle Devonian trackways10.