

Two Arms to Hold... Something



***T. Rex* was a king among dinosaurs—huge, fierce and frightening. But it's the giant reptile's tiny small arms that create the most enduring mystery**

By Jay Ingram

If you were lured into watching the latest *Jurassic Park* knock-off, *Jurassic World*, you know that top billing was reserved for a fictitious hybrid dinosaur the filmmakers called *Indominus*. The introduction of this creature relegated *T. rex* and even the velociraptors to supporting cast status. But to suppose that *T. rex* has nothing more to offer us is wrong; it is still a wonderful—and mysterious—beast.

Of course, in the CGI world, *Indominus* is pretty impressive. But *T. rex* ruled the *real* world. We know it could reach 12 metres in length, stand four metres tall at the hips and weigh nearly seven tonnes. To reach those dimensions, teenage *T. rex*s would go on a weight-gaining spree, putting on something like 600 kilograms a year from ages 14 to 18.

They were also fierce. Their bite force was astounding (likely the most powerful ever seen on Earth—10 times that of an alligator) and they could probably manage speeds of eight metres per second. But there is one feature of *T. rex* that has puzzled experts since their discovery: their tiny forelimbs.

On a full-sized *T. rex*, the forearms are only about a metre long. When the first skeleton of *T. rex* was displayed a hundred years ago, the American paleontologist Henry Fairfield Osborn, having in hand only the upper arm bone, the humerus, imaginatively reconstructed the beast with a long, three-fingered forearm. The first complete set of *T. rex* forelimb bones was only discovered in 1989, and they confirmed what many had suspected from related species: it had absurdly short arms. Too short even to reach its mouth.

The immediate question was, what were these arms good for? Some dismissed them as vestigial, envisioning a progressive shrinking from hypothetical ancestors, animals like the smaller carnivorous dinosaurs that had full-length prey-catching arms. The problem with that idea was that, however short, *T. rex*'s forearms were heavily muscled. If they were being gradually marginalized evolutionarily, it wouldn't make sense to retain that kind of musculature. They must have had a role to play. (Osborn himself recognized that

and speculated they might have been involved in sex—but don't forget, he didn't know how incredibly short those arms actually were.)

And heavily muscled is an understatement: judging from the thickness of the arm bones (three times the size of ours) and the huge areas on them for the attachment of muscles and tendons, the arm was at least the thickness of a human thigh. The biceps attached further down on the forearm than on ours, giving it more leverage; each arm alone could likely curl 200 kilograms. And the biceps didn't act alone; they had help from surrounding muscles, especially the huge shoulders. On the other hand, the range of movement wasn't great: straightening your arm then touching your shoulder takes your elbow through 165 degrees, where the *T. rex* version could only manage 45 degrees, and very little side to side movement at all.

Inferring power from fossil traces is one thing. It's also possible to create mathematical models of the *T. rex* forearm. Just plug in the known values and calculate what they were capable of. These calculations arrive at the same results: the forearms were powerful and fast.

So what did this powerful but apparently undersized piece of machinery do? My favourite explanation was offered by Barney Newman in 1970. Newman envisioned a *T. rex* "in a position of rest," lying face-down, jaw on the ground. How would it get up? The force would come from the giant hind legs, but if they just pushed, the animal would skid forward on its belly. Instead the first thing it would do is dig in its front claws and do a pushup. By doing that, it's in a position to rock backward—and up—eventually standing on its hind legs.

Newman's idea hasn't exactly been shot down, but nor has it prevailed. Much more emphasis these days is placed on the notion that somehow these mini-arms actually were useful in feeding. And there is evidence that they were used in hazardous situations, because many of the surviving fossil *T. rex* arm bones have been chipped, cracked and broken, apparently by excessive forces.

If all those arms were used for was propping the animal up, it's hard to see how they would incur such damage. At the same time, it's also challenging to imagine a *T. rex* embracing a multi-tonne *Triceratops*, positioning the animal so its giant jaws can make the kill, using tiny bulging arms.

And so the debate continues. In the end, it's our imaginations that create these scenarios. In that respect, *T. Rex* may not be so different from *Indominus*. But even in the imaginary world, *T. rex* still reigns supreme. 🐾