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Whiskers, nipples, venom, and head-butting: how imaging unravels the brain and paleobiology of our pre-mammalian ancestors

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What is probably considered among the most influential paper about pre-mammalian palaeo-neurology states that “early cynodonts possessed low-resolution olfaction, poor vision, insensitive hearing, coarse tactile sensitivity, and unrefined motor coordination” (Rowe et al. 2011). This reflects the fact that the fossilized neuroanatomy of mammalian ancestors has long been considered extremely conservative. Using X-ray microtomography to access previously out-of-reach internal structures on the extraordinary wealth of South African Karoo fossils - which chronicles the origin and evolution of therapsids in exquisite details - our research team was able to trace back the evolution of several important neurological features through geological times. This work supports that there is more to therapsids palaeo-neurology that has usually been assumed. For instance, it highlights that the therapsid brain and inner ear display an unsuspected variety of shape and size. This hidden diversity relates to the onset of some important biological features, such as hearing, balance, intelligence and warm-bloodedness. Our research furthermore shed some fresh light on the evolution of the pineal eye and trigeminal nerve, which support an early origin of hair, whiskers and lactation some 241 million years ago, well before the origin of crown mammals. The study of the maxillary canal in therapsid also provides a gateway to the evolution of many other palaeobiological traits. It showed that sexual display and head to head fighting likely played a major role in mammalian evolution since the very origin of therapsids and that some mammalian ancestors evolved envenoming capacities millions of years before snakes. Overall, it is safe to state that imaging is currently revolutionizing our understanding of the palaeobiology of mammalian forerunners.

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