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## **Spina bifida in an Early Triassic tetrapod from South Africa**

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Spina bifida ('split spine') is a birth defect that results in an incomplete closing of the vertebral column, which is likely caused by a combination of genetic and environmental factors. It is a common pathology among humans and also occurs in other vertebrates, but has only very rarely been reported in fossils, previously restricted to Pleistocene and Holocene age. Here we report the occurrence of this birth defect in the dicynodont therapsid *Myosaurus gracilis* from the Lower Triassic *Lystrosaurus* Assemblage Zone of the South African Karoo Basin.

Dicynodont anomodonts are the most abundant and taxonomically diverse clade of Permian–Triassic tetrapods that evolved many different body plans and ecological specializations [1]. These include fully terrestrial, semi-aquatic, arboreal, and fossorial ecomorphs, which are mainly reflected in their postcranial skeleton, as cranial anatomy in the group remained largely conservative [2,3,4]. Some of the most specialized dicynodonts are the small, burrowing cistecephalids *Cistecephalus* and *Kawingasaurus*, which belong to the more inclusive clade Emydopoidea. In most recent phylogenies, the Early Triassic emydopoid dicynodont *Myosaurus gracilis*, known from South Africa and Antarctica, has been recovered as the sister taxon to Cistecephalidae, and therefore is crucial to understanding the evolution of fossoriality in the group.

For this purpose we CT scanned the most complete specimen of *Myosaurus* (BP/1/4269), consisting of a small skull (4.1 cm long) and the anterior part of the postcranial skeleton, including part of the vertebral column, ribs, a virtually complete pectoral girdle (with both scapulae, procoracoids, coracoids, clavicles, an interclavicle, and a sternum), as well as two partial humeri. The postcranium of *Myosaurus* is characterized by a reduced number of cervical vertebrae, a well-ossified and developed pectoral girdle, but an overall slender morphology when compared to cistecephalids. Both humeri are missing their distal ends, but display a broad proximal end and slightly enlarged processes for muscle attachments not developed to the extent seen in *Cistecephalus* and *Kawingasaurus*, indicating that *Myosaurus* was a possibly a rather facultative burrower without the extreme mole-like specializations seen in the postcrania of cistecephalids.

Most interestingly, the CT scan further revealed the vertebral pathology known as spina bifida, characterized by split neural arches, that was previously only known from extant and some Pleistocene vertebrates. Specifically, the split spine is present in the axis, associated with a spondylolisthesis (a displacement of the vertebral centrum), and cervical 3. Moreover, the cervical series appears to be strongly amphicoelus to notochordal, which, however, possibly represents a phylogenetic signal rather than an association with the reported pathology.

*References:*

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