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Scientific note

First record of tail bifurcation in *Colobosauroides cearensis* (Squamata, Gymnophthalmidae)

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Caudal autotomy is the ability to release tail for escape predation (Meyer *et al*. 2002). Many lizards utilize this defense mechanism across several families in response to the attack of predators (Bateman & Fleming, 2009). After successful autotomy, the lizard regenerates its tail within a few weeks (Clause & Capaldi 2006). This new tail usually replaces the autotomized tail, however, there may be complications during the regeneration process, giving rise to some morphological anomalies, such as the appearance of supernumerary tails (Henle & Grimm-Seyfarth 2020). Here we report the first case of tail bifurcation for the Colabosauroides cearensis Cunha, Lima-Verde & Lima, 1991, a microteid distributed in Northeastern Brazil, associated with relictual forest environments of the Caatinga Domain (Soares & Caramaschi 1998).

We identified in the herpetological collection of the Núcleo Regional de Ofiologia at the Universidade Federal do Ceará, an individual (male) of C. cearensis (CHUFCL 7011; SVL = 42.93 mm; Figure 1A) presenting a supernumerary tail. The specimen was collected in April of 1992, inside the Campus of the Universidade Federal do Ceará (3° 44' 48" S/38° 34' 29" W, WGS 84; 21 m.a.s.l.), municipality of Fortaleza, Northeastern Brazil. The bifurcation, which is quite unobtrusive (Figure 1B), occurred at a height of 14.13 mm after the cloacal opening giving rise to a larger branch measuring 13.40 mm belonging to the original tail, already autotomized in a more distal region and a second branch, barely evident, emerging laterally, measuring 3 mm. Approximately 0.2 cm thick serial cuts of the caudal modification were sent for routine histological processing and stained with Hematoxylin Eosin to visualize the general structure and Masson Trichrome to highlight the mesenchymal origin tissues (connective, cartilage, muscle and bone). The slides were analyzed by optical microscopy.

The cross-sections of C. cearensis tail anatomical structure present the tail's typical and normal tissues: epaxial and hypaxial subdermal muscle bundles, a layer of submuscular adipose tissue, the spinal cord in the dorsal position and the caudal vertebra with functional hematopoietic tissue to the center (Figure 2). Furthermore, ectopic muscle bundles are observed in the center of the tail, ventral right position to the caudal vertebra. There is a focal deposit of collagen (fibrosis) in the left hypaxial muscles and multifocal staining affinity changes in the muscle fibers (Figure 3). Finally, chondrocytes

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can be visualized in the vertebral periosteum producing neoformed hyaline cartilage.

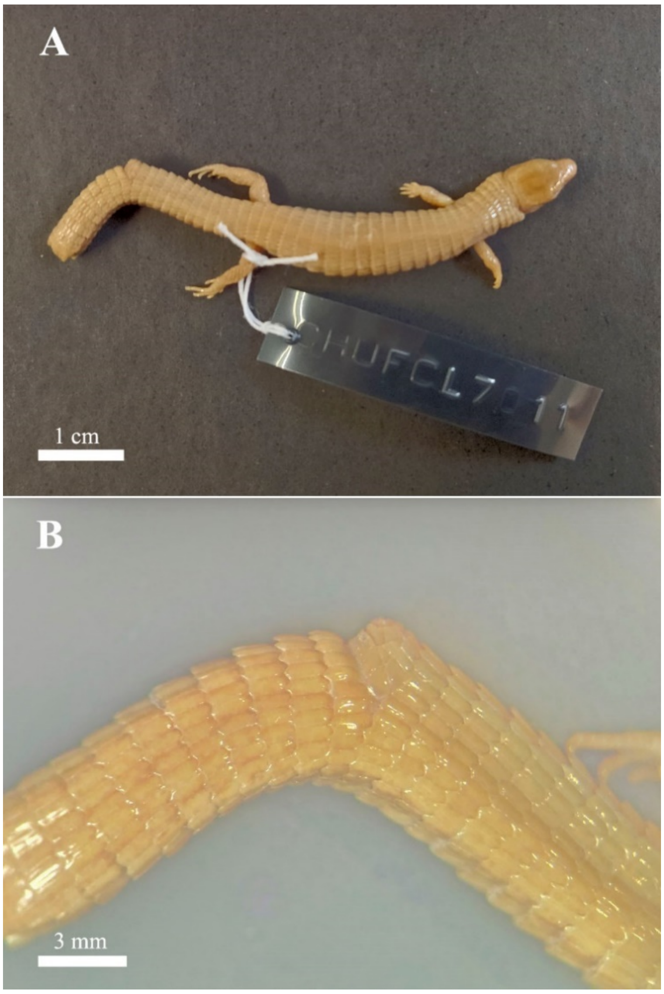

Figure 1. Individual of *Colobosauroides. cearensis* with bifurcated tail collected in the municipality of Fortaleza, Ceará (A); Bifurcation close (B). Photo: Ramos, A.R.L. (2021).

The macro and microscopic findings suggest an incomplete tail fracture resulting from a possible traumatic event. Focal muscle fibrosis indicates necrosis with inflammation, and consequent healing of hypaxial fibers and acidophilic-colored fibers suggest active multifocal muscle neoformation. The cartilage fragment and the ectopic muscle bundles represent blastema cells and imply that a focal regeneration process was initiated but partially evolved, creating a forked tail end that emerged from the injured site in the left middle lateral region of the original tail.

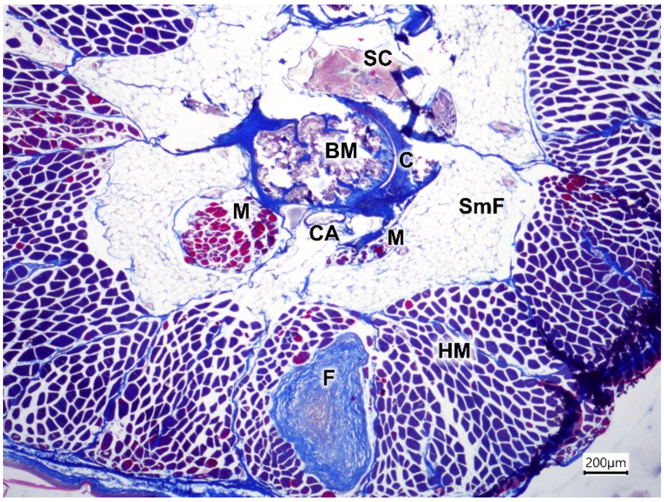

Figure 2. C. cearensis tail, histology, cross-section. Masson Trichrome, 40x. The original structures are hypaxial musculature (HM), spinal cord (SC), vertebral bone marrow (BM), submuscular adipose tissue (SmF), caudal artery (CA). The regenerated structures are hyaline cartilage (C) and ectopic neoformed muscle bundles (M) within the adipose tissue. There is also focal fibrosis in the hypaxial musculature (F).

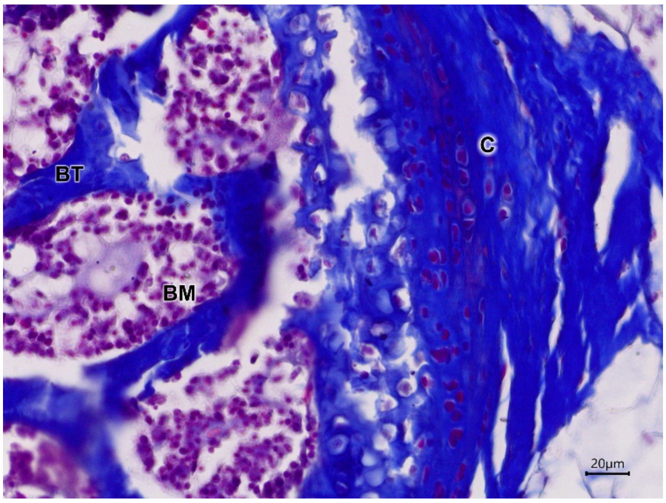

Figure 3. C. cearensis tail, histology, cross-section. Masson Trichrome, 400x. Detail of cartilage forming (C) on the right dorsal vertebral edge. It was also observed original adjacent structures, bone trabeculae (BT) in the vertebral foramen, and bone marrow (BM).

Tail bifurcations are usually caused by failures during the regenerative process, resulting from incomplete autotomy, where the tail does not fully detach but breaks enough to stimulate the growth of a new tail at the injury site (Dudek & Ekner-Grzyb 2014). Although there are no robust studies on the effects of supernumerary tails on individuals with these anomalies, the presence of these changes can negatively affect fitness, since the tail plays an important role in social relationships and the ability to escape from predators (Passos *et al.* 2014). This observation represents the second report of tail bifurcation in Gymnophthalmidae (Pheasey *et al.* 2014) and the first for the genus *Colobosauroides*.

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