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Ontogeny and phylogeny of the tympanic pneumatic system of crocodyliform archosaurs

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The tympanic cavity of archosaurs gives rise to a variety of epithelial diverticula that pneumatize the bones of the braincase and suspensorium. Tympanic pneumaticity is not well understood with regard to its ontogeny, morphological variability, and phylogenetic distribution. Moreover, the relationship of true tympanic pneumaticity to other pharyngeal pneumatic systems in the braincase has been completely unexplored. We present here a survey of the development of this diverticular system both as an ontogenetic trajectory in *Alligator mississippiensis*, and as a phylogenetic pattern within crocodylomorphs. Methods include CT scanning, microCT, and 3D visualization, which together provide a detailed characterization of the pneumatic recesses relative to the skeleton, otic labyrinth, and brain cavity. Additionally, CT scans of extant taxa, coupled with dissection, give insight into the soft-tissue associations of the diverticula. To shed light on the highly derived condition of adult crocodylians, ontogeny of pneumatic sinuses is traced via microCT in a large growth series of American alligators, ranging in age from embryos to adults. Some sinuses show relative expansion during ontogeny (dorsal tympanic diverticulum), whereas others become relatively reduced (laterosphenoid and quadrate diverticula) or even lost in the adult (pterygoid diverticulum). Morphological similarities between sampled fossils and extant taxa are examined in a phylogenetic context, allowing tests of hypotheses of homology. Focal fossil taxa include the protosuchian *Eopneumatosuchus*, the thalattosuchian *Pelagosaurus*, the goniopholidid *Eutretauranosuchus*, and the sebician *Hamadasuchus*. Tympanic pneumaticity of basal taxa (e.g., *Eopneumatosuchus*) more closely resembles that of young alligators whereas more crownward taxa (e.g., *Eutretauranosuchus*) resemble adults.