ABSTRACT

Archosaurs (crocodylians, birds and their extinct relatives) underwent numerous evolutionary transitions in appendicular skeletal morphology, reflecting a diverse suite of postural and behavioral adaptations. Among archosaurs, saurischians (sauropodomorph and theropod dinosaurs) evolved a wide diversity of hip joint morphology and locomotor postures, as well as spanning seven orders of magnitude in body size. Large saurischians possess hip joints in which the bony surfaces differ in shape and size, suggesting large volumes of articular soft tissues. The lack of anatomical data in extant archosaurs and the poor preservation of joint soft tissues in fossil forms hinder functional inferences of archosaur hip joints, thus complicating attempts to understand the locomotor behavior, ecology, and evolution of this diverse clade. In this study, I first described the soft tissue anatomies and their osteological correlates in the hip joint of archosaurs and their sauropsid outgroups, and infer structural homology across the extant sauropsids using dissection, imaging, and histology. Secondly, I used maximum likelihood ancestral state reconstruction and osteological correlates to infer trends in hip joint soft tissue transitions within Saurischia. Lastly, I used 3D imaging techniques and phylogenetically corrected correlation to test the relationships among hip joint dimensions, morphological characters, and body size of sauropodomorph and theropod dinosaurs. Giant sauropods and theropods convergently evolved incongruent bony hip joints. In sauropods, the femoral head is capped a thick layer of hyaline cartilage, and functioned to resist massive axial compressive loads. In contrast, theropods covered their femoral head and neck with thinner hyaline cartilage, and maintained the femoral neck-antitrochanter articulation to accommodate shear forces during femoral abduction and axial rotation. These data indicate that the archosaur hip joint underwent divergent transformations reflective of body size, locomotor posture, and joint loading.