

Public Abstract

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Title:3D analysis of hip joint mobility and the evolution of locomotor abilities in Miocene hominoids

The emergence of extant ape-like locomotor behaviors has become a defining issue in reconstructing ape evolution. Suspensory positional behaviors, such as brachiation, antipronograde bridging, vertical climbing, and orthograde clambering and transfer, distinguish extant hominoids from Old World monkeys and most New World monkeys. Most fossil hominoids aligned within the crown group seem to lack suspensory adaptations but this is a point of contention because fossil hominoids usually display a mosaic of anatomies. Although previously untested, it has been widely theorized that suspensory behaviors involve highly abducted hip joint postures, potentially permitting suspensory behaviors to be inferred from joint function rather than relying on isolated morphologies. This thesis tests whether adaptations for suspensory behaviors can be inferred in fossil nonhuman hominoids from the hip joint.

The first study tests the association between suspensory behaviors and hip mobility in anesthetized living anthropoids (*in vivo*). Suspensory taxa (n=55; gorillas, chimpanzees, orangutans, gibbons, siamangs, spider monkeys) were found to have significantly higher passive ranges of abduction and external rotation compared to non-suspensory taxa (n=49; capuchin and Old World monkeys).

The second study developed a digital modeling technique to estimate range of hip abduction and then tested the accuracy of the modeling approach against the live animal data. Hip joint abduction and the abducted knee position were reconstructed in a large sample of extant anthropoids (n=252) and then quantitatively compared these simulations to the *in vivo* data for passive range of abduction. Suspensory taxa were significantly larger in both simulated abduction (degrees) and abducted knee position (mm), although there was overlap between locomotor groups. Abducted knee position more closely approximated the *in vivo* measurements than the angular measures of abduction. However, locomotor group could be correctly classified in discriminant function analysis using both measures of abduction and the results provided a hypothetical framework for how to interpret abduction modeled in fossil taxa.

The final study modeled hip abduction in early Miocene hominoid *Proconsul nyanzae* (KNM-MW 13142), late Miocene crown hominoid *Rudapithecus hungaricus* (undescribed pelvis and RUD 184 femur), and several large-bodied Plio-Pleistocene fossil cercopithecoids (*Paracolobus mutiwa*, *Paracolobus chemeroni*, *Theropithecus oswaldi*) using the validated modeling approach from the second study. Abduction simulations in *Proconsul nyanzae* and fossil cercopithecoids yielded abduction with a high posterior probability of being classified as non-suspensory, which is consistent with the locomotor reconstructions for these fossil taxa. Estimated abduction in *Rudapithecus hungaricus* was exclusively in the range of extant suspensory anthropoids and was most similar to the values observed in spider monkeys and hylobatids. This study provides the first evidence for suspensory behavior in a Miocene ape based on joint function, and demonstrates the forelimb-dominant locomotor behaviors can be inferred using hip joint mobility. Taken together, these studies provide important information for reconstructing the timing and emergence of suspensory behaviors within crown hominoids.