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Anatomy

## Is the scapula a good indicator of taxonomy?: A geometric morphometric analysis using macaque monkeys

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### Abstract

In primates, scapular shape is often thought to correlate to locomotor patterns with distinct morphologies observed in arboreal versus terrestrial species. However, the extent to which intra-generic morphological differences might be related to taxonomic differences as opposed to convergent locomotor behaviors remains to be tested. Thus, we tested the hypothesis that closely related, but behaviorally distinct, species may exhibit variation in their scapular morphology that match known phylogenetic relationships among the species macaque monkey. Our sample ( $n = 230$ ) represented nine species; *M. fascicularis*, *M. mulatta*, *M. fuscata*, *M. arctoides*, *M. radiata*, *M. nigra*, *M. nemestrina*, and *M. sylvanus* and a Colobine outgroup (*Trachypithecus cristatus*). 3D scans of the left scapula were taken using an HDI structured light scanner and 5 landmarks and 61 sliding semilandmarks were applied to the scans to capture overall form. Following Procrustes superimposition, Canonical Variates Analysis (CVA) was performed and Procrustes coordinates were extracted and used for a Discriminant Function Analysis (DFA). The results of the CVA showed clear differences between *Trachypithecus* and macaques, as well as between *M. fuscata* and *M. radiata* and all other macaques. In the cross-validated DFA, only 34.1% of individuals were correctly classified. The outgroup *Trachypithecus* showed a correct classification rate of 70%, as did *M. nigra* consistent with relatively distinct morphology in this taxon. Overall, patterns of morphological variation observed in the CVA do not match phylogenetic history,

therefore suggesting environmental factors might influence the pattern of morphological variation among macaque species in novel ways, though this remains to be tested.

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