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The Anatomical Record

Title: 4-6: Musculoskeletal modeling untangles the origins of mammal forelimb function and posture

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The 'sprawling–parasagittal' transition was a major postural shift that occurred in the ancestors of mammals, [PSE1] underpinned by musculoskeletal reorganization of the limbs. However, 'when' and 'how' this important postural shift occurred is unknown. While the anatomical changes characterizing this transition can be traced through the fossil record, how these relate to functional changes, and the acquisition of parasagittal posture, remains poorly understood. Here, we produced three-dimensional musculoskeletal models of the forelimbs of extant (n=3) and fossil (n=8) taxa that phylogenetically and functionally span the sprawling–parasagittal transition. We calculated joint range of motion (ROM) to determine a 3D pose space, using the novel APSE algorithm (Accelerated Pose Searching with Electrostatics). We then estimated muscle moment arms (MMAs) across the entire pose space for all muscles crossing the shoulder and elbow joints. Models of extant species were validated against empirical measures of ROM and MMA derived from ex vivo XROMM (X-ray reconstruction of moving morphology). Among extant species, our parasagittal taxon occupied a distinct region of pose-space, with more retracted and depressed shoulder joint angles. MMA data show increased emphasis on shoulder elevation associated with a parasagittal posture, but greater shoulder depression in sprawlers. Results from the fossil species show complex, non-linear patterns of forelimb transformation, demonstrating that the 'sprawling-parasagittal' transition is characterized by homoplasy and postural variation within the mammalian lineage.

Title: P2-17: Osteological Correlates of Carnivoran Masticatory Fascicle Lengths

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Previously, we found dietary correlates of masticatory muscle architecture in carnivorans, including across Canidae, Felidae, and Musteloidea. Namely, fascicle lengths (FLs; a correlate of gape) scale according to dietary size in certain lineages, while bite force proxies (muscle mass and physiological cross-sectional area; PCSA) scale with body size across the order. Although we
subsequently used these data to confirm osteological correlates of muscle mass and PCSA, until now, no one has confirmed osteological correlates of FLs in carnivorans – approaches that would, for instance, allow paleontologists to reconstruct gape abilities in extinct taxa. In this current study, we evaluated the correlation of origin to insertion as well as cranium only and mandible only osteological proxies with chemical dissection-based FL for this same sample