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HIND LIMB USE AND LOADING PATTERNS IN PRIMATES WITH DIFFERENT LOCOMOTOR REPERTOIRES

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Defining the functional importance of hand-assisted bipedalism within the locomotor repertoire of the great ape common ancestor may benefit from clarifying how much suspensory Asian apes habitually support body weight (BW) with hind limbs. Because BW is transferred through subchondral bone of limb articular surfaces, creating compressive joint reaction forces, maximum radiodensity patterns in subchondral bone contain information on habitual joint loading. If suspensory apes support substantial BW with hind limbs, e.g., hand-assisted bipedalism versus foot-assisted forelimb suspension, we predict areas of maximum radiodensity in distal tibia subchondral bone may resemble areas in quadrupeds and bipeds. We compared suspensory, quadrupedal, and bipedal primates (n=54). We acquired serial computed tomography scans of distal tibiae and analyzed subchondral bone to infer habitual tibiotalar joint loading. Although non-significant, quadrupeds exhibit larger areas of maximum radiodensity in the distal tibia compared to suspensory primates, similar to distal radius patterns. Opposite our predictions, bipeds have surprisingly small areas of maximum radiodensity, similar to their distal radius. Although directly comparing radial and tibial data is not possible, significant differences between quadrupeds and suspensory primates in relative areas of maximum radiodensity in distal radii and non-significant differences in distal tibiae suggest similar hind limb and dissimilar forelimb compressive loading. This is consistent with the hypothesis of non-trivial compressive loading in the hind limbs of suspensory apes (e.g., functionally important weight support during forelimb-assisted bipedalism). It is premature to suggest that these results prioritize a forelimb-assisted bipedal condition over a knuckle-walking condition for the common ancestor of apes.

Keywords: apes, locomotor behavior, functional morphology, bone apparent density