Estimates of fossil hominin quadriceps physiological cross sectional area from patellar dimensions.

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Many aspects of limb function, including strength and fatigue resistance, are determined by muscle dimensions. Reconstructions of fossil hominin locomotor abilties are hampered by a lack of reliable methods for estimating muscle dimensions from skeletal elements. Here, we test whether the patella, a sesamoid bone of the quadriceps complex tendon, is a reliable indicator of physiological cross-sectional area of the quadriceps muscle group. We examined the relationship between linear dimensions of the patella and the physiological cross-sectional area (PCSA) of the quadriceps muscle complex in hominoids (*Hylobates*, *Nomascus*, *Symphalangus*, *Pongo*, *Gorilla*, *Pan*, and *Homo*), a strepsirhine (*Lemur fulvus*), a common European rabbit (*Oryctolagus cuniculus*), and a common housecat (*Felis catus*). We calculated patellar cross-sectional area in two planes: sagittal (the product of anterior-posterior thickness and superior-inferior height), and transverse (the product of anterior-posterior thickness and mediolateral width). Both the sagittal plane cross-sectional area (SCSA) and the transverse plane cross-sectional area (TCSA) were significantly correlated with the PCSA of the quadriceps complex ($P<0.001$ for both; $r^2=0.99$, 0.97 respectively), independent of osteological indices of body size (e.g., femoral head dimensions). These relationships across the primate and greater mammalian sample provide a new approach for reconstructing locomotor performance and ecology in extinct taxa where the patella is preserved. Estimates of fossil hominin PCSA from the SCSA and TSCA regressions suggest an increase in quadriceps size beginning in the genus *Homo*.

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