On the cross-sectional form of the patella in several primates

Christopher David Stanford Jones
MAppSc, BAppSc

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Department of Anatomical Sciences

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Abstract

This study was performed to investigate the patterns of morphometric variation of the primate patella in cross-section, in an attempt to understand further the influences upon bone morphology. Specimens were selected from *Homo*, *Gorilla*, *Cercopithecus* and *Colobus*. These genera were chosen to investigate variation in patellar form in primates that are (1) bipedal and quadrupedal, (2) large and small, and (3) closely and distantly related. Therefore, there was the potential to uncover morphometric patterns that reflected such influences as function, body size, sex differences and phylogeny, and the aims of this study were formulated to investigate these influences. Variables chosen for this study were based on the patellar outline on cross-sectional computed tomography images: elliptic Fourier amplitudes, and also the outline perimeter length and the area contained within the outline.

Ordination using principal component analysis and cluster analysis showed continuous distributions of specimens, and it appeared that the bulk of intragenus variation was based on patellar size differences. Although cluster analysis showed patellae from *Homo* and *Gorilla* on one hand, and *Cercopithecus* and *Colobus* on the other, to be clearly separated, there was no clear separation among genera: specimens at extremes on PCA tended to be clustered with the next genus. Given the large disparities in average body weights for these genera, it was expected that patellar size would differ widely. This pattern was present in nonhuman primates; humans represented a deviation from this pattern, having large patellae relative to average body weight; it was likely that this was due to larger forces associated with bipedal locomotion. Principal component analysis showed that morphometric variables were correlated to varying extents; there were strong correlations between the conventional variables, so that the specimens were linearly arranged, with an effective reduction in phenotype space from two dimensions to one. Although the dimension of Fourier variables could be reduced, two dimensions were required, which was in part reflective of the dominance of two of the ten variables; only seldom was reduction to one dimension possible. An inference of geometric similarity was made in some cases; in other cases, size differences were associated with shape differences, but no clear pattern of shape differences was seen. Specimens within genera were found to show sexual size dimorphism. Occasionally sexual shape dimorphism was found, but not so that results could be related to an influential factor (function, for example). Published average body weights suggested that patellar size dimorphism was a reflection of body weight dimorphism.

Thus, patellar size differences dominated the picture of morphological variation, and this reflected genus body weight averages, although function also prevailed, and human patellae were large considering body weight averages for *Homo*. Clear sexual size dimorphism reflected body weight dimorphism, but results for shape dimorphism did not appear to reflect functional differences assumed to exist between smaller and larger individuals. Although size and shape differences did follow a pattern that did not contradict phylogenetic relations, this was also explicable in terms of body size and function.