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First insights into trabecular bone distribution in the first metacarpal of *Homo naledi*

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Modern human dexterity is thought to be facilitated by our distinctive pollical (thumb) morphology. The shape of the first metacarpal (Mc1), including the robusticity of the shaft and disto-radial flange as well as the articular surfaces of the first metacarpophalangeal and trapeziometacarpal joints, have been used to infer the degree of dexterity in several hominin species [1-4]. The *Homo naledi* Mc1 has a unique external morphology among known fossil hominins with no direct analogue in extant primates, possessing a small proximal articular surface, a flat radio-palmarly extended distal articular surface, and both radial as well as ulnar diaphyseal flanges [3-4]. As trabecular bone can (re)model in response to mechanical loading over an individual's lifetime and is located beneath both epiphyseal and diaphyseal Mc1 external morphology, it may provide additional functional information about *H. naledi* thumb use. Compared to other living great apes, humans have significantly more trabecular bone directly beneath the radial aspect of both the distal and proximal articulations of the first metacarpal, as well as beneath the disto-radial flange. These differences are consistent with differences in both external Mc1 morphology and observed manipulative capabilities [5].

Here, we use canonical holistic morphometric analysis (cHMA) to statistically compare the distribution of relative trabecular bone density (rBV/TV) in largely complete H. naledi Mc1s (U.W. 101-1321 and U.W. 101-270) to a sample of living great apes including: modern humans (*Homo sapiens*, n=10), bonobos (*Pan paniscus*, n=10), chimpanzees (*Pan troglodytes*, n=11), gorillas (*Gorilla gorilla*, n=10) and orangutans (*Pongo* sp., n=7). Run in Medtool 4.5 (www.medtool.at), this method uses a statistical deformation model to create a canonical Mc1, to which all Mc1s are subsequently deformed. This controls for shape differences before statistical volumetric comparison of trabecular distribution. The trabecular distribution of the whole bone, the proximal epiphysis, the distal epiphysis, and the diaphyseal medullary cavity of the fossils, were each separately compared to the homologous region of the comparative sample.

H. naledi Mc1s demonstrate some intraspecific variation in trabecular distribution. We find evidence for radial concentration of trabecular bone beneath the proximal and distal articular surfaces of U.W. 101-1321 consistent with the modern human pattern, thought to reflect thumb loading during forceful opposition. U.W. 101-270 does not show this signal as clearly. However, both fossils show trabecular concentrations beneath both the ulnar and radial diaphyseal flanges, suggesting a plastic response to strong first dorsal interosseous and opponens pollicis muscle action. We hypothesize that the antagonistic actions of these muscles assisted in the maintenance of stability at the small proximal articulation of the Mc1 in *H. naledi*, but ongoing analysis of the large hypodigm available for this species is needed to properly support this supposition.

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