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Does 1st metatarsal cortical thickness distribution in the Dmanisi hominin differ from that of modern humans?

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Two first metatarsals from Dmanisi (D2671, D3442) are analyzed. Early work demonstrated that the Dmanisi lower limb and ankle morphology are similar to modern humans. Less-derived metatarsal morphology, on the other hand, demonstrates similarity to earlier hominins. Here, we analyzed cortical thickness patterns in first metatarsal shafts of African apes and fossil hominins. We ask whether Dmanisi hominin 1st metatarsals are more similar to modern humans than extant apes, and whether they are more derived (human-like) relative to other hominin first metatarsals.

First metatarsals of chimpanzees, gorillas, modern humans, and fossils were CT scanned. For each metatarsal, we measured 17 cross sections from 25% to 65% of diaphyseal mechanical length. In each cross section, we measured thickness of the cortical wall radially at one degree increments. Cortical thicknesses were size standardized, after which they were used in a penalised discriminant analysis (PDA) to assess extant species-specific and fossil patterns.

Dmanisi metatarsals patterns of thickness distribution are not similar to modern humans. This indicates that at 1.8 my some aspects of foot anatomy have yet to be fully transformed into the modern human condition. Variability in shaft stiffness of Dmanisi metatarsals from various orientations could imply that these elements did not behave as a relatively unidirectional rigid propulsive lever and shock absorption mechanism, to the same extent as observed in modern humans, during bipedal gait. However, the degree to which the observed differences in metatarsal cortical thicknesses express a functional signal requires continued investigation.

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