Can muscle architecture explain the variability in the first metacarpal morphology? Inferences on human hand evolution.

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Résumé

Previous studies have proposed that our ability to produce and use stone tools has been the primary selective pressure explaining the evolution of the human hand. Derived traits in the human hand include a robust thumb metacarpal, particularly at the head and the base, and a moderate trapeziometacarpal joint curvature in both radioulnar and dorsovolar aspects. Along with other anatomical peculiarities, humans can exert forceful precision and power grips, and resist load during tool production and use. Despite that this is a biomechanical explanation for the morphology of the human hand, limited work had been done using soft tissue and therefore, the relationship between the muscles most strongly recruited during tool production/use and the derived traits in the hand bones remains to be thoroughly investigated. We have dissected 15 forearms of wet human cadavers of known sex and age at death. An estimate of the force magnitude was calculated by means of the physiological cross-sectional area (PCSA) of the muscles that arise and insert on the first metacarpal (first dorsal interosseous, opponens pollicis and abductor pollicis longus muscles). Variation in PCSA, muscle mass and fiber length was compared with metacarpal morphology. The bones were documented using photogrammetry and the 3D models were analyzed by applying geometric morphometrics. For comparison purposes, analogous information from non-human primates available at the literature and digital databases were studied. We aim to relate muscle architecture and the functionally influenced bony variables, and provide some light into the question of whether the evolution of the first metacarpal was related to its musculature.

Mots-Clés: First metacarpal, muscle architecture, photogrammetry, geometric morphometrics

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