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MORPHOFUNCTIONAL STUDY OF HOMINOID HANDS USING COMPUTER SIMULATION TECHNIQUE

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Understanding the functional anatomy of the hands in humans and African apes is essential for estimating manipulative ability of fossil hominoids and clarifying the evolution of morphofunctional basis for the human precision grip capabilities. We therefore constructed three-dimensional anatomical models of the human and chimpanzee hand musculoskeletal systems. The hand skeleton was described as a chain of 20 links connected by revolute joints, joint centers and rotation axes of which were determined based on quadric surface approximation of joint surfaces. Muscle paths were defined as a series of points connected by line segments. Such anatomically realistic model of the complex hand musculoskeletal system allows us to investigate how the morphology of the hands facilitates or restricts manipulative capabilities. Using the constructed hand models, we simulated pincer grasp and estimated the direction and magnitude of maximum possible grip force vectors. We also conducted a virtual knockout experiment of muscles to predict functional significance of each of the muscles on grasping capabilities. Comparisons of the simulated results suggested that human morphological features especially that in the first dorsal interosseous muscle may facilitate pincer grasp. The present computer simulation technique based on the anatomical musculoskeletal models presents potentials for elucidating morphofunctional relationships of the hand musculoskeletal systems and hopefully predicting manipulative dexterity in extinct hominoids from fossil hand bones.

Keywords: biomechanics, musculoskeletal system, precision grip, force