BIOMECHANICAL ANALYSIS OF THE FRONT KICK WITH THE DOMINANT AND NON-DOMINANT LIMB IN THE SHITO-RYU STYLE OF KARATE

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INTRODUCTION: The kinematics of the ideal martial arts kick, and the best ways to train martial artists to achieve it, are both relatively unknown in the traditional, western biomechanics and kinesiology literature.

METHOD: Our subject was a 21-year old male, who began studying karate at age 3, and has attained the rank of nidan (second degree) in Hayashi-Ha Shito-Ryu Karate. We captured video images of the subject while he performed several kicks with each limb. Reflective markers were attached to 14 anatomical locations. Analysis Methods: Video capture, creation of three-dimensional digital models, and calculation of linear and angular kinematics were performed with the APAS* system.

RESULTS and DISCUSSION: We divided the kick into four phases based on previously published, traditional, qualitative analyses (Baker, D & Moreau J, 2005), and calculated the linear and angular kinematics of each body segment during each phase.

We discovered potential flaws in the assumptions regarding each phase; for example the beginning of the 'chamber' phase defined as the point in time when tibia is vertical, does not represent a change of direction of any of the major joints. We discovered a previously undescribed kinematic pattern of combined hip extension, knee extension, and ankle plantarflexion just prior to contact with the target that probably represents an underlying strategy of co-contraction of major muscle groups to maximally stiffen the lower extremity. We also discovered that the kinematics of non-dominant limb kicks, when examined one joint at a time, were quite similar to the dominant limb. However, angular and linear velocities were far lower, and the relative timing of each joint was quite different. The speed of martial arts movements make them virtually impossible to analyze with the naked eye, and many traditional assumptions about optimal techniques may be flawed.

CONCLUSION: Computer-assisted videography has the potential to dramatically improve the level of knowledge of biomechanists, practitioners, and coaches.

REFERENCES:
*Ariel Performance Analysis System, Ariel Dynamics, Inc, San Diego, CA, USA

Baker, D & Moreau J, (2005) Beginning Karate Course Notes, SW Texas University, (http://www.fac.swt.edu/Beginning%20Karate/k040.html)