# KNEE AND ANKLE JOINT KINEMATICS IN KENDO MOVEMENT AND THE REPEATABILITY

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**KEY WORDS:** martial arts, Achilles tendon injury, motion analysis

**INTRODUCTION:** *Kendo*, a Japanese martial art of sword fighting, comprises strike and thrust motion against a specific target of a part of an opponent's body. Among kendo athletes, chronic Achilles tendon (AT) injuries are frequently observed only on the left side probably because a main power source lies in the left side of the lower body for the repetitive forward-back bounding steps in the strike motion. It has been reported that the AT injury may be linked to abnormal joint biomechanics among runners. In order to make better clinical decision on the AT injury treatment in kendo athletes, therefore, we should focus on joint biomechanics of the left side of the lower extremity in kendo movement. The purpose of the study was to demonstrate the joint kinematics of knee and ankle in the kendo movement and quantify the repeatability.

**METHOD:** Ten male collegiate kendo athletes (mean(±SD) age 20.5±1.1 years; height 172.8±4.5 cm; weight 76.1±9.7 kg; the kendo experience 12.1±2.4 years) attended the study and five of the participants were also tested a different day approximately at intervals of one week. After the informed consents were given, we instructed the participants to execute three sets of the kendo strike motion with a single forward step toward the target object. We obtained the joint kinematics data of the left ankle flexion-extension, rearfoot inversion-eversion, knee flexion-extension during the single support phase in the motion by an eight-camera Mac3D motion analysis system (Motion analysis corp., Santa Rosa, CA, USA). The coefficient of multiple correlation (CMC) was used to assess the repeatability of joint angle waveforms within a test day and between test days. Statistical significance was set as $P \leq 0.05$ in this study.

**RESULTS AND DISCUSSION:** Figure1 illustrated the representative data of the joint angle curve during the single stance phase. The CMC within a test day was from 0.986 to 0.999 in ankle flexion-extension angle, from 0.890 to 0.998 in rearfoot inversion-eversion angle, and from 0.930 to 0.999 in knee flexion-extension angle in the participants. The CMC between the test days were from 0.966 to 0.992 in ankle flexion-extension angle, from 0.710 to 0.996 in rearfoot inversion-eversion angle, and from 0.716 to 0.993 in knee flexion-extension angle. The current result suggests that it may be reasonable to make a clinical decision by using the result of single kendo motion analysis for experienced kendo athletes.

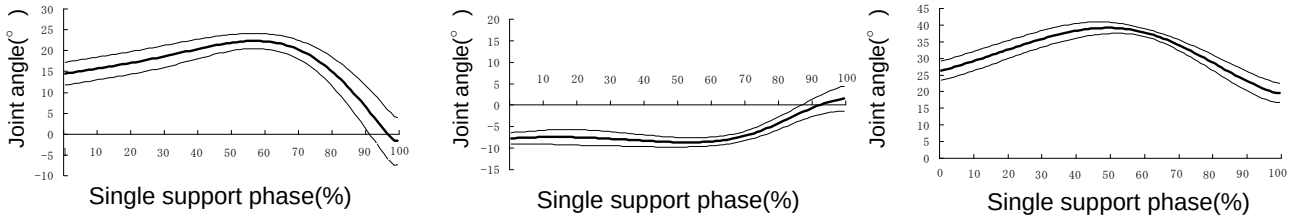


**Figure1. Mean and standard deviation of joint motion (degrees) for the representative participant in ankle flexion-extension, (b) reafoot inversion-eversion, and (c) knee flexion-extension during the single stance phase of left leg in the kendo movement**

**CONCLUSION:** The knee and ankle joint kinematics in the kendo motion may be quite repeatable both within a test day and between test days.