An electromyographic study of the lower limb muscles during Fumikomi movement in Kendo and Karate athletes

Masaki Fumoto1, Kentaro Tai2, Yukiko Takami3, Tatsuo Yagi1

1Tokyo International University, 2Nagasaki International University, 3Seiwa University

Introduction: Recent psychological and physiological studies suggest that higher levels of sports and physical performance are executed under fully relaxed but highly concentrated situations. Previous studies of Kendo and Karate in Japan report that more efficient Fumikomi movements, which increase the speed and sharpness of the striking movement by pushing oneself off the floor with the hind leg and moving forward with a sharp stamp of the front leg, were achieved by using the change in potential energy produced by an instantaneous loss of strength in the muscles around the knee of the front leg. We defined this momentary loss of strength in the muscles of the front leg as Nuki. In the present study, we evaluated whether the pre-motion silent period (PSP) of electromyography (EMG), which we hypothesized to accompany the Nuki, was observed during the Fumikomi movement in Kendo and Karate athletes. Methods: Subjects were athletes of Kendo and Karate with more than 6 years of experience. One of the Kendo athletes was a World Kendo champion. The Fumikomi tasks were Men-uchi for Kendo and Kizami-tsuki for Karate. Both tasks were repeated 20 times at a self-selected time interval with an opponent. EMG was recorded from the rectus femoris (RF) and biceps femoris of the front and hind legs, and triceps brachii of the left or right side using bipolar surface electrodes. We also measured the pattern of respiration using an airflow sensor. EMG signals were amplified with a time constant of 0.03 sec and high-pass filtered with a cutoff frequency of 500 Hz. EMG signals were digitized at a sampling rate of 1 KHz and stored on a memory card. The full-wave rectified and averaged EMG signals were used for further analysis. Results: Both weak and tonic EMG activities were observed in the front and hind legs of Kendo and Karate athletes before Fumikomi movements. During Fumikomi movements, the PSP of the RF of the front leg occurred immediately before the EMG onset of the RF of the hind leg. Moreover, there was a phase of expiration (exhalation) just prior to the PSP. Discussion: The PSP during the Fumikomi movement in the present study was similar to that of the single joint movement and whole body movements in previous studies. The purpose of the PSP in the present study was thought to produce a momentary fall of the center of gravity. Consequently, it was confirmed that the Fumikomi movements were attained by the Nuki, which was induced by instantaneous loss of strength in the knee muscles of the front leg. Moreover, we found that the respiration phase of expiration occurred immediately before the PSP. These results suggest that skillful performance of the Fumikomi movement in Kendo and Karate athletes was achieved by effective coordination between respiration and the Nuki.