Introduction
Pre-motion silent period (PMSP) preceding a rapid voluntary movement is related to a higher speed of voluntary movement as well as larger acceleration and force exertion during the succeeding rapid contraction. It is hypothesized that stretching of agonist muscle before rapid voluntary movement is related to improvement of muscle performance. However, to our knowledge, there are few studies that confirmed pre-stretching of the agonist muscle after the appearance of PMSP. Thus, to confirm pre-stretching of the agonist muscle, the present study investigated an in vivo behavior of muscle architecture after the appearance of PMSP using ultrasonography in the vastus lateralis muscle (VL).

Methods: Seven men (26.6±2.8 years) volunteered for this study. The subjects were asked to maintain a standing posture with knee joints flexed at 50 degrees. Thereafter, the subjects were requested to perform knee extensions as quickly as possible. We measured EMG until the appearance of 10 PMSP. The EMG signal was measured from VL, vastus medialis muscle and hamstring muscle using bipolar surface electrodes. In addition, ultrasonic images were recorded using a 7.5 MHz linear-array ultrasound probe (PLM-703TA, Toshiba, Japan) from the VL. The probe was fixed with surgical tape on the VL. Real-time ultrasonic image of VL during PMSP was continuously recorded on a computer at 101 Hz. Changes in the cross points between a VL fascicle and aponeurosis during PMSP appearance was measured.

In addition, one of the subjects subsequently performed rapid isometric knee extension at different preliminary contraction intensities (10%, 20%, 30%, 40%, and 50% of maximal voluntary contraction: MVC).

Result: In the all trials in which PMSP appeared, VL showed stretching movement. The distance of movement the cross points between the VL fascicle and aponeurosis ranged from 0.02 to 3.46 mm. This movement at the cross point of VL began up to 50 ms after PMSP appeared. The starting period of cross point movement in VL was most frequently observed 20-30 ms after PMSP appearance. There was a significant relationship between the duration of PMSP and the distance of cross point movement in VL (r=0.63, p<0.01). Furthermore, there was a significantly negative relationship between duration of PMSP and the intensity of preliminary contraction. However, there was no relationship between the distance of cross point movement in VL and the intensity of preliminary contraction.

Conclusion: The present study indicates that when PMSP appeared in the VL before knee extension, pre-stretching movement occurs in the VL. In addition, intensities of preliminary contraction may influence the duration of PMSP, but not the distance of cross point movement in VL.

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