



# Effect of interelectrode distance on EMG-force relationship of vastus intermedius muscle in women

Aya TOMITA<sup>1</sup>, Akira SAITO<sup>1,2</sup>, Ryosuke ANDO<sup>1</sup>, Kohei WATANABE<sup>3</sup> & Hiroshi AKIMA<sup>1</sup> (<sup>1</sup>Nagoya University, <sup>2</sup>JSPS Research Fellow, <sup>3</sup>Chukyo University)

**✂ This is SAMPLE. This had been presented in other past congress (ACSM 2014).**

## Abstract

**PURPOSE:** The purpose of this study was to clarify the effect of interelectrode distance on EMG-force relationship of VI in women.

**METHODS:** Ten healthy women and nine healthy men participated in this study. We measured the subcutaneous fat thickness of electrode placement site of the VI using ultrasonography. Subjects performed isometric knee extension with 25%, 50%, 75% and 100% of maximal voluntary contraction (MVC). During the task, EMG signals were recorded from the superficial region of VI using surface EMG with interelectrode distances of 10 mm (IED-10) and 20 mm (IED-20), simultaneously. The root mean square (RMS) of VI during submaximal contraction was normalized by RMS of 100% MVC.

**RESULTS:** The subcutaneous fat thickness of VI in women was significantly larger than that in men. The normalized RMS increased in proportion to contraction level. There was no significant difference in normalized RMS between IED-10 and IED-20 for women. Similar result was observed in men.

**CONCLUSION:** We found that for both women and men, EMG-force relationship of VI was independent of interelectrode distance in this study. This result suggests that recording of the VI using surface EMG would be applicable for women with interelectrode distances of 10 mm or 20 mm with similar sensitivity of EMG signal to men.

## Background

- It is thought that vastus intermedius (VI) plays a key role in QF 1,2.
  - EMG activity of VI during muscle contraction for men was recorded<sup>3</sup>, however, it is unknown whether surface EMG recording of VI for women is available.
  - EMG signal would be affected by the subcutaneous fat. The lower subcutaneous fat thickness the higher EMG amplitude<sup>4</sup>.
  - Minetto et al.<sup>5</sup> recorded surface EMG of vastus lateralis (VL) and vastus medialis by 5 to 25 mm interelectrode distance (IED) for lean and obese patients. In obese patients, EMG-force relationship was significant difference normalized EMG 15 mm IED as the border.
  - Women has larger subcutaneous fat thickness than men generally.
- ⇒ We need to pay attention to subcutaneous fat thickness when using our previous recording surface EMG technique of VI<sup>3</sup> for women.
- ⇒ We need to assess the effect of IED on EMG activities of VI for women.

## Purpose

To examine effect of IED on EMG-force relationship of VI muscle during isometric knee extension in women.

## Methods

**Subjects:** Ten healthy women (21.9 ± 6.3 years, 159.2 ± 5.2 cm, 49.3 ± 4.7 kg) and nine healthy men (23.7 ± 2.7 years, 171.9 ± 7.7 cm, 69.1 ± 12.0 kg).

**Knee extension task:** Subjects performed 25%, 50%, 75% and 100% of the maximal voluntary contraction (MVC) during isometric knee extension at knee joint angle of 90°.

**Surface EMG recording:** Surface EMG was recorded from VI during isometric knee extension task. IEDs were IED-10 and IED-20 (Figure 1).

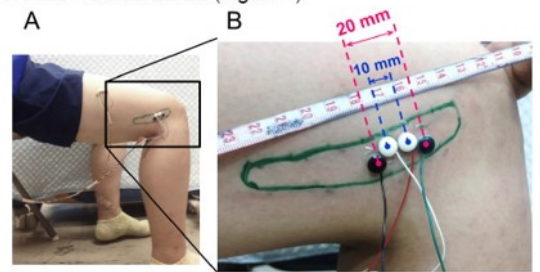


Figure 1. A: The picture of attaching electrode on superficial region of VI for the woman. This picture was taken the lateral side of right leg. B: Green line is superficial region of VI identified by ultrasound. Interval of center to center of white electrodes is 10 mm, and that of black electrodes is 20 mm.

**Measurement of subcutaneous fat thickness:** Before the attaching the electrodes, two traverse ultrasound images were obtained at the recording site of the surface electrodes of VI at the knee joint angle of 90° (Figure 2). The subcutaneous fat thickness was calculated as the perpendicular distance between the surface of the skin and the superior muscle fascial layers.

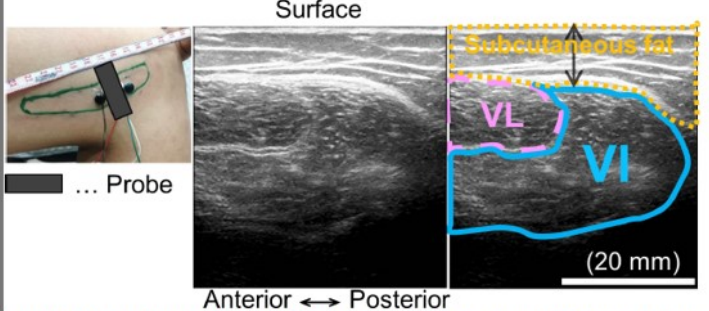


Figure 2. The ultrasound image of place of attachment electrodes of VI for the woman.

**Analysis:** Root mean square (RMS) of VI were normalized by RMS of MVC during isometric knee extension (Normalized RMS). Median frequency of the EMG signals were calculated for each trail the frequency spectrum of the EMG (1024 points, hamming window processing 50% overlap).

## Results

**Subcutaneous fat thickness:** The subcutaneous fat thickness of VI in women (8.7 ± 2.1 mm) was significantly larger than that in men (5.6 ± 1.6 mm) (p < 0.01).

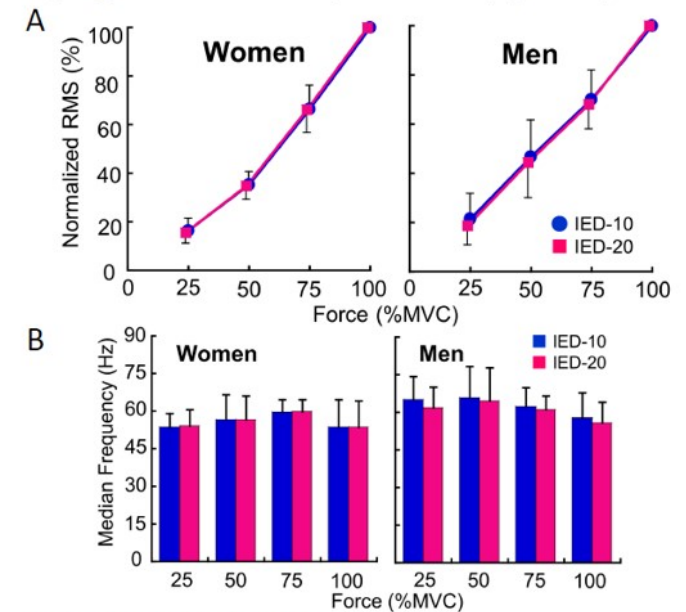


Figure 3. A: EMG-force relationship in VI. B: Median Frequency in VI at the each voluntary contraction for women.

**EMG-force relationship (Figure3A) and Median Frequency (Figure3B):** There were no significant difference between IED-10 and IED-20 for men and women in VI.

## Conclusion

EMG-force relationship was not affected by IED on recording surface EMG of VI for women. It is suggested that it is able to record surface EMG of VI in women.

## Contact

tommyrico51kyu@gmail.com

## References

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