# INFLUENCE OF SKIN TEMPERATURE ON MECHANOMYOGRAM OF M. BICEPS BRACHII

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## INTRODUCTION

Mechanomyogram (MMG) is mechanical counterpart of myoelectric activity and it has gained considerable attention as a new noninvasive tool to investigate the muscular functions. The main mechanisms of MMG signal generation has been considered to be pressure waves generated by lateral expansion of the active muscle fiber [1].

It is well known that the changing of muscle temperature concerns the electrical and mechanical function (i.e., electromyogram: EMG and contraction torque, respectively) of the muscle [2,3]. The present study was therefore performed to examine the relation between the MMG properties and the muscle temperature.

## METHODS

Nine healthy male volunteers, aged from 21 to 26 years, participated in this study. The reference condition of skin temperature was attained in room air of 23-25 ºC that resulted in the skin temperature of about 34 ºC which was called "control" condition. The muscles of upper arm were cooled with over 20 minutes down to a skin temperature of 20 ºC (i.e., "cold" condition). At some other day, the muscles were heated up to a 40 ºC (i.e., "heat" condition). In each skin temperature, the EMG and MMG signals were measured on m. biceps brachii during isometric contraction. The maximum voluntary contraction (MVC) was measured in the "control" condition. The subjects maintained contraction level of 20%, 40%, and 60% MVC. The surface EMG signal was picked up by the bipolar Ag/AgCl electrodes (5mm pick-up diameter, 20 mm inter-electrode), placed over the muscle belly along the underlying muscle fiber. The MMG signal was detected by the piezo-electric accelerometer with weight of 2g (9G111BW, NEC Sanei Instruments Ltd.). The accelerometer was placed with double-sided adhesive tape at mid point between the EMG electrodes. The contraction torque, EMG and MMG signals were simultaneously and continuously stored into a personal computer through an A/D converter with 12-bits resolution and with sampling frequency 1-kHz. The root mean square amplitude (RMS) was computed from both signals of EMG and MMG. ANOVA was used to determine the EMG and MMG characteristics at three different temperatures (control, cold, and heat). Significances of individual differences were evaluated by using the Scheffé test if ANOVA was significant.

## RESULTS AND DISCUSSION

The mean ± SD of MVC of nine subjects was 22.9 ± 3.6 kg. The effect of skin temperature on the relation between the RMS of EMG and MMG and the contraction level was shown in Fig. 1. The RMS values of EMG and MMG were increased with increasing of the contraction level in all skin temperature. The RMS of EMG was not significantly influenced by the skin temperature. This was in good agreement with the previous studies [2,3]. The RMS of MMG significantly increased with increasing the skin temperature at each contraction level. The present results might be related to the contraction time of muscle fibers and the viscosity of muscular tissue. These data can be extended to the notion that the MMG is a reliable method to investigate muscular function under a wide range of physiological conditions.

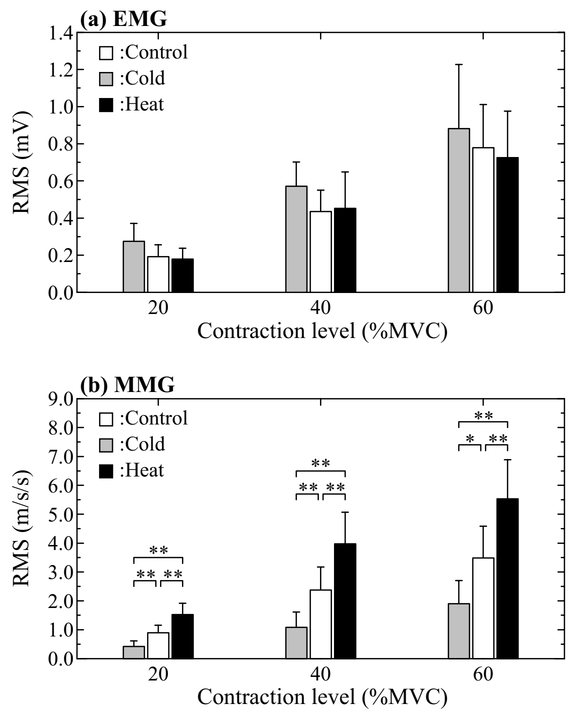


Fig.1: The effect of skin temperature on the relation between (a) RMS of EMG and the contraction level and (b) RMS of MMG and the contraction level. The marks of * and ** are $p<0.05$ and $p<0.01$, respectively.

## CONCLUSIONS

The main purpose of this study is to examine whether or not the RMS of EMG and MMG could reflect the contraction properties of muscle during cooling and heating of the skin surface. The results were obtained as the following. (1) RMS of EMG was not almost influenced by the skin temperature. (2) RMS of MMG significantly increased with the increasing of skin temperature.

## REFERENCES

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