

# Muscular Activity in Maximum Voluntary Contraction of M. Quadriceps Femoris

~Testing with Mechanical Vibration (Mechanomyogram: MMG)~



<sup>1,2</sup> Toshifumi Dakeshita, <sup>1</sup> Hiroya Kudo, <sup>1</sup> Koichi Wakimoto, <sup>1</sup> Yoshihiro Uchida, <sup>1</sup> Atsuo Kato, <sup>2</sup> Akira Kubo, <sup>3</sup> Kazuyoshi Sakamoto

<sup>1</sup> Seisen Clinic of Orthopedics, Shizuoka, Japan Email: [dakeshita@seisen.info](mailto:dakeshita@seisen.info)

<sup>2</sup> International University of Health and Welfare, Graduate school

<sup>3</sup> Center of Promotion of Alliances with Region, Industry and Government, The University of Electro-Communications, Tokyo, Japan

## Background & Introduction

**Therapeutic exercise = Muscle strength assessment ⇒ exercise prescription**

Physiological data in muscle contraction includes action potential or electromyogram (EMG) and mechanomyogram (MMG), where EMG and MMG are the electric vibration before muscular contraction and the mechanical vibration after muscular contraction, respectively. Many researchers had reported correlation between action potential and muscle strength, but not between MMG and muscle strength.

## Aim

**How to move the Quadriceps Femoris in muscle contraction?**

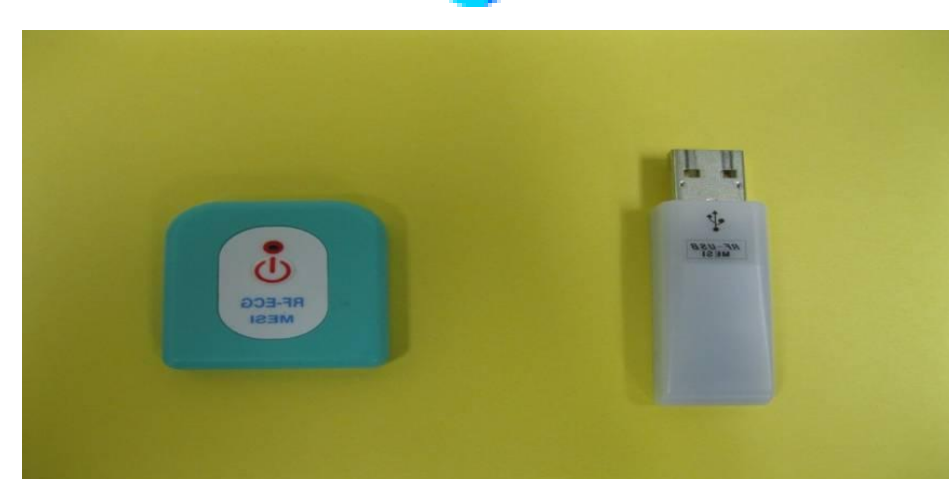
**What is the relationship between muscle strength and MMG?**

Our research focused on MMG or mechanical vibrations in muscle construction.

## Material & Method



15 men  
13 women  
average age  $28.9 \pm 7.7$

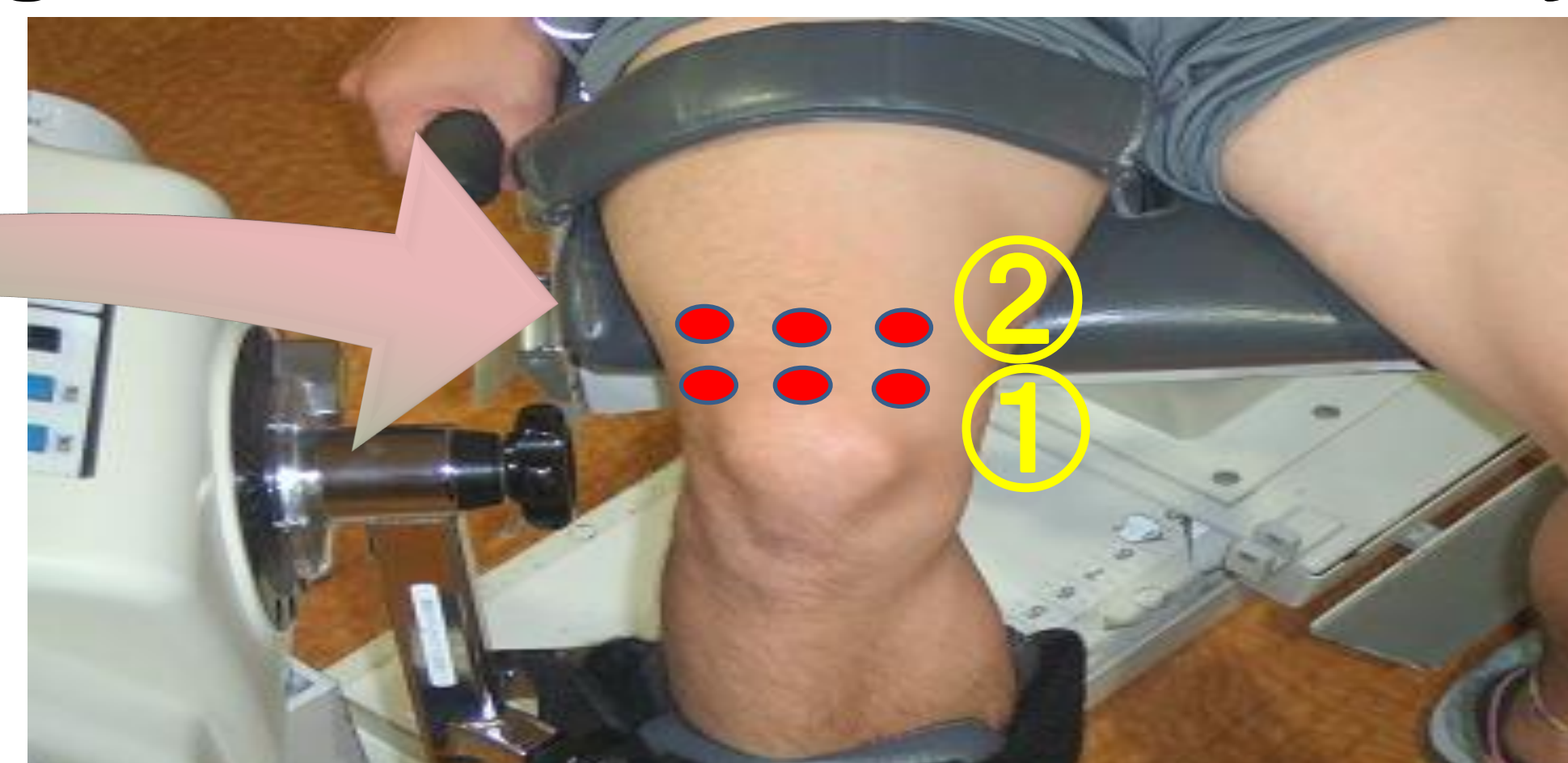


CCI 3D accelerometer



BIODEX System 3

**Both MMG and muscular strength were measured concurrently at six points:**

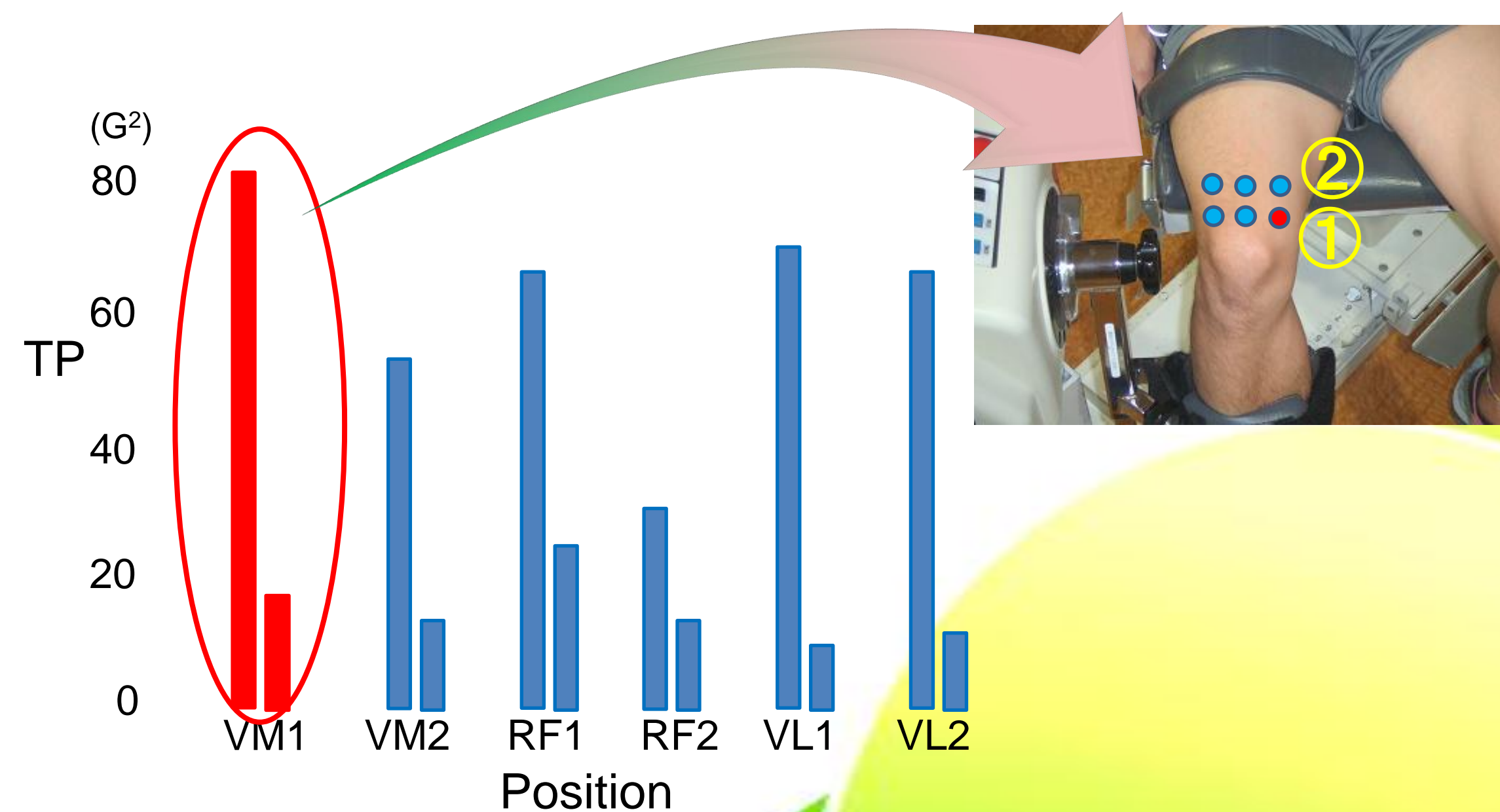


Respective two places on three muscles of vastus medialis, rectus femoris, and vastus lateralis, where two places were taken by 5 cm and 10 cm from the upper edge of patella.

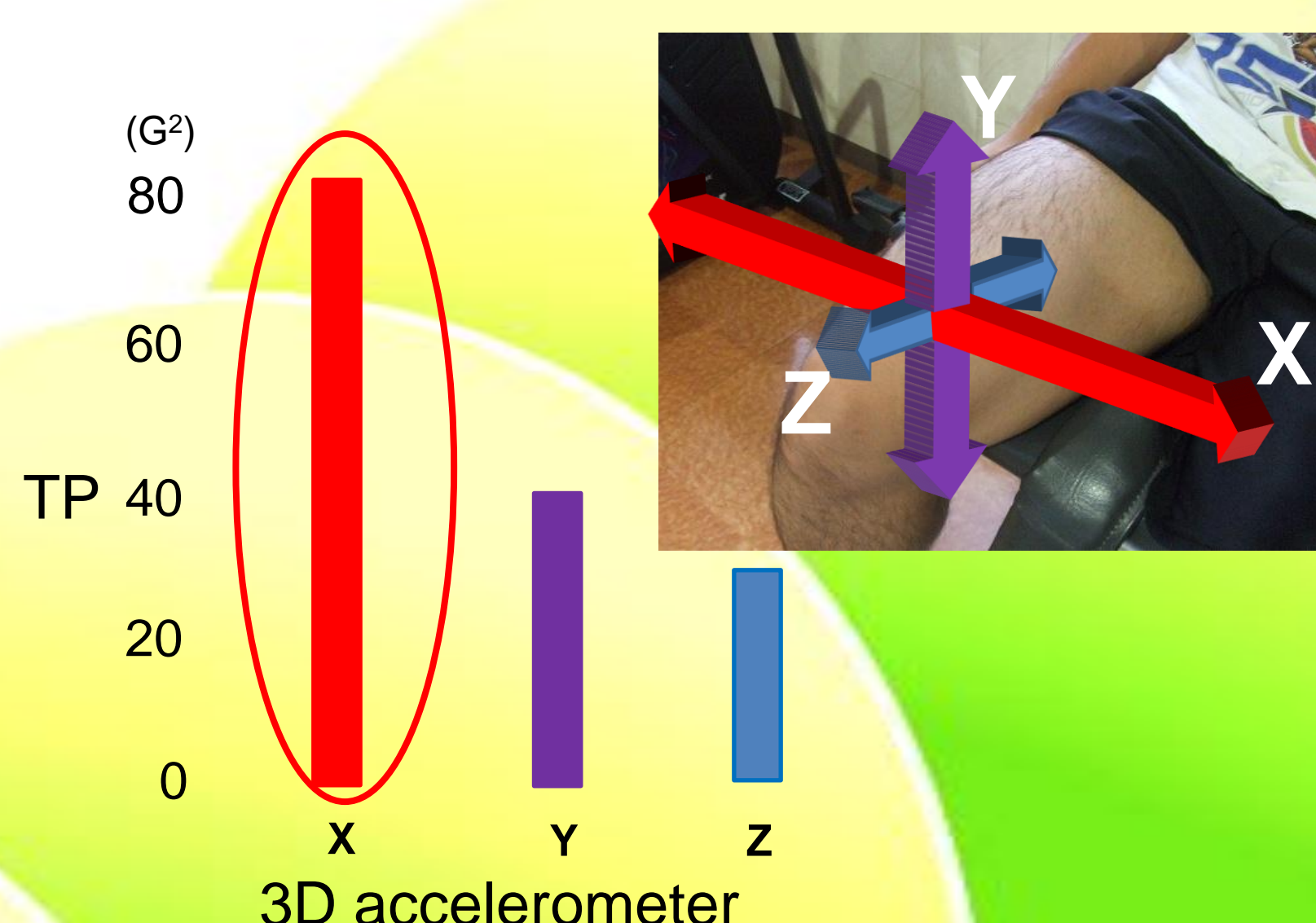
## Analysis

The power spectrum was calculated by auto-regression (AR) model with four degrees. Total power (TP) was determined by multiplying sum of power spectrum within the specified frequency range by fundamental frequency. Simple correlation coefficient was used to find correlation between MMG and muscle strength

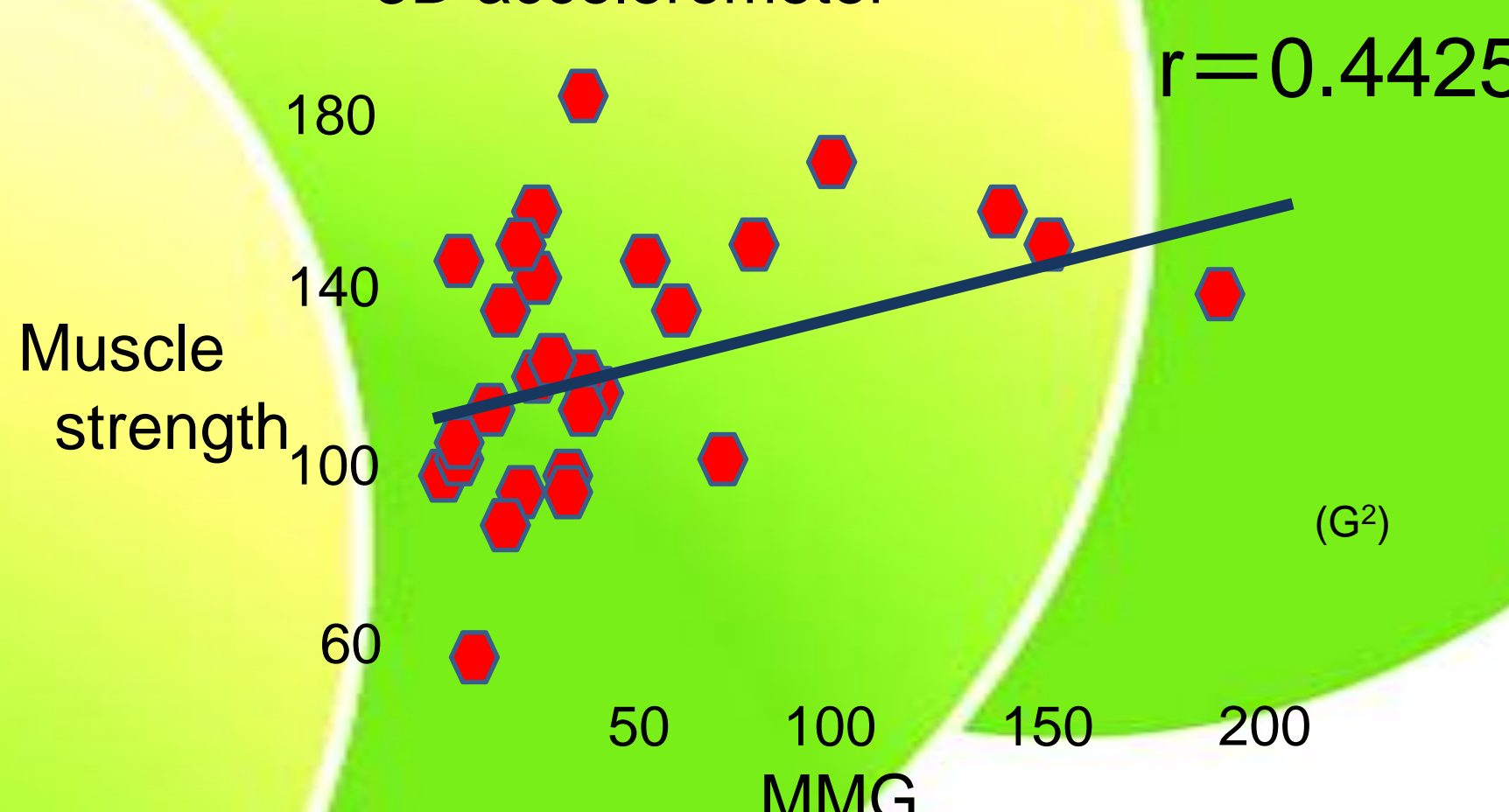
## Result



The maximum TP in MMG was obtained at the point in the vastus medialis muscle located approximately 5 cm from the upper edge of the patella.



The maximum mechanical vibrations were obtained in the horizontal direction.



The significant positive correlation was found between MMG and muscle strength.

## Conclusion

Andriacchi (1984) showed that in knee extension in isometric contraction, the maximum action potential was obtained in the vastus medialis muscle. Likewise, the maximum MMG was obtained there in our research. This demonstrates that knee joint extension correlates with the vastus medialis muscle. In addition, the maximum MMG was obtained in the horizontal direction rather than the front/back or vertical direction. That was probably because amplitude was more limited in the front/back or vertical direction due to the tendon or skin under tension caused by the fully stretched anterior femur. Many things are still unknown regarding muscle contraction when full muscular strength is delivered. However, the findings from our research may lead to the discovery of new muscle functions. In addition, the significant positive correlation between MMG and muscular strength means that MMG may become new indicator to test isometric muscular strength.