



# Assessment of muscle contraction features by using Tensiomyography

Shogo Tsutsumi <sup>1)</sup>, Yukio Urabe <sup>1)</sup>,  
Noriaki Maeda <sup>1)</sup>, Kazuhiko Hirata <sup>2)</sup>

- 1) Graduate School of Biomedical & Health Sciences, Hiroshima University, Hiroshima, Japan
- 2) Division of Rehabilitation, Clinical Support Department, Hiroshima University Hospital, Japan

# 【Background】

## Muscle function assessment

### Isokinetic dynamometer

- For athletes with sports injuries
- Joint exercise (Multiple muscle)

[  
✓ Quantitative  
✓ Qualitative  
assessment

(Mochizuki et al., 2001)

Insufficient as a measuring equipment of  
the qualitative assessment of muscle

# Tensiomyography (TMG)

TMG can be visualized the muscle contraction reaction by electrical stimulation

- ❑ Contraction speed
- ❑ Muscle stiffness
- ❑ Muscle fatigue
- ❑ Fiber type

(Rey E et al., 2012 , Rusu LD et al., 2013)

# Features of the TMG

Non-invasive

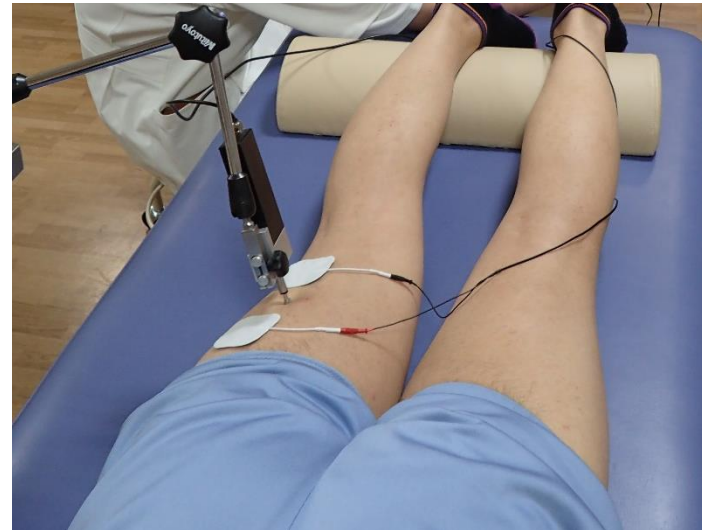
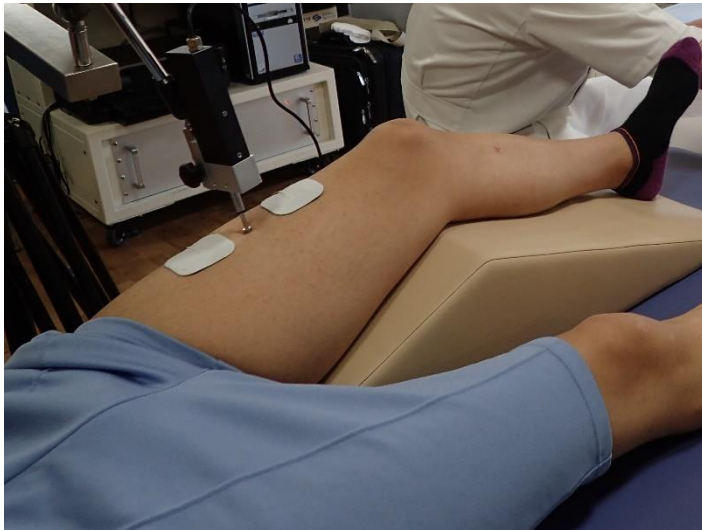
Simple & Easy

High reliability

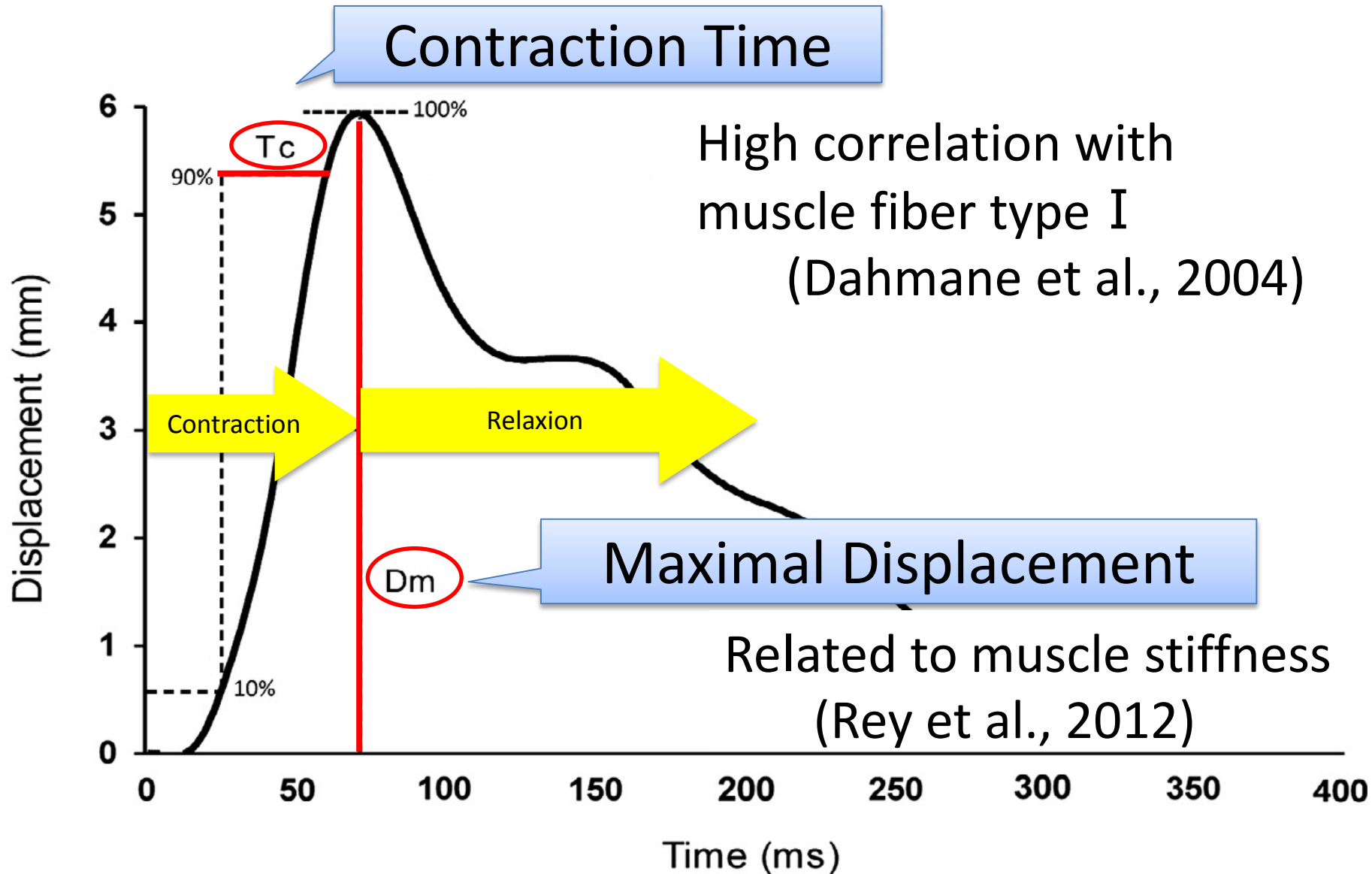
# Measurement protocol

- Start electrical stimulation from 20 mA
- Amplitude was progressively increased by 10 mA increments until there was no further increase maximal displacement of maximal stimulator output (110mA)

(Rey et al., 2012)



# Measurement item of TMG



## Previous study about TMG

- High intraclass and interclass reliability  
(Krizaj et al., 2008 , Tous-fajardo et al., 2010 , Simunic , 2012 )
- Contraction time of the rectus femoris of anterior cruciate ligament injuries  
31.3 ms(preoperative) ⇒ 27.3 ms(1 year later)  
(Pedro et al., 2014 )

## Muscle strength

- ◆ There is a positive correlation with the muscle cross-sectional area

male > female

(Fukunaga, 1978)

## TMG (Muscle contraction feature)

- ◆ Correlation with muscle strength ?

Gender difference ?

# 【Aim】

To clarify gender differences the values of TMG and correlation between muscle strength and muscle contraction features using TMG



To consider the value of as a measurement equipment of TMG

# 【Hypothesis】

Muscle contraction features by TMG shows the specific trend.

- ✓ Not found gender difference
- ✓ Not high correlations with muscle strength

# 【Participant】

6 male & 6 female (recreation level) with no history of orthopedic diseases in the lower extremities

	Age (years)	Height(cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )
male	23.4 ± 5.3	171.1 ± 6.1	66.0 ± 7.5	22.5 ± 1.9
female	21.0 ± 3.2	161.2 ± 4.5	54.5 ± 3.8	21.0 ± 1.1

(Mean ± SD)

- Measurements limb is the side kicking the ball, all subjects were right leg

Carried out with the approval of the Hiroshima University Graduate School of Medicine, Dentistry drugs Health Sciences mind and body function life control Sciences ethics committee (No.1474)

# 【Measurement items】

## Knee muscle strength

### Biodex System3

- Angular velocity:  $60^{\circ} /s$  ,  $180^{\circ} /s$
- Maximal torque value at the time of knee extension and flexion (weight ratio)

## Muscle contraction features

### TMG-100 (TMG-BMC)

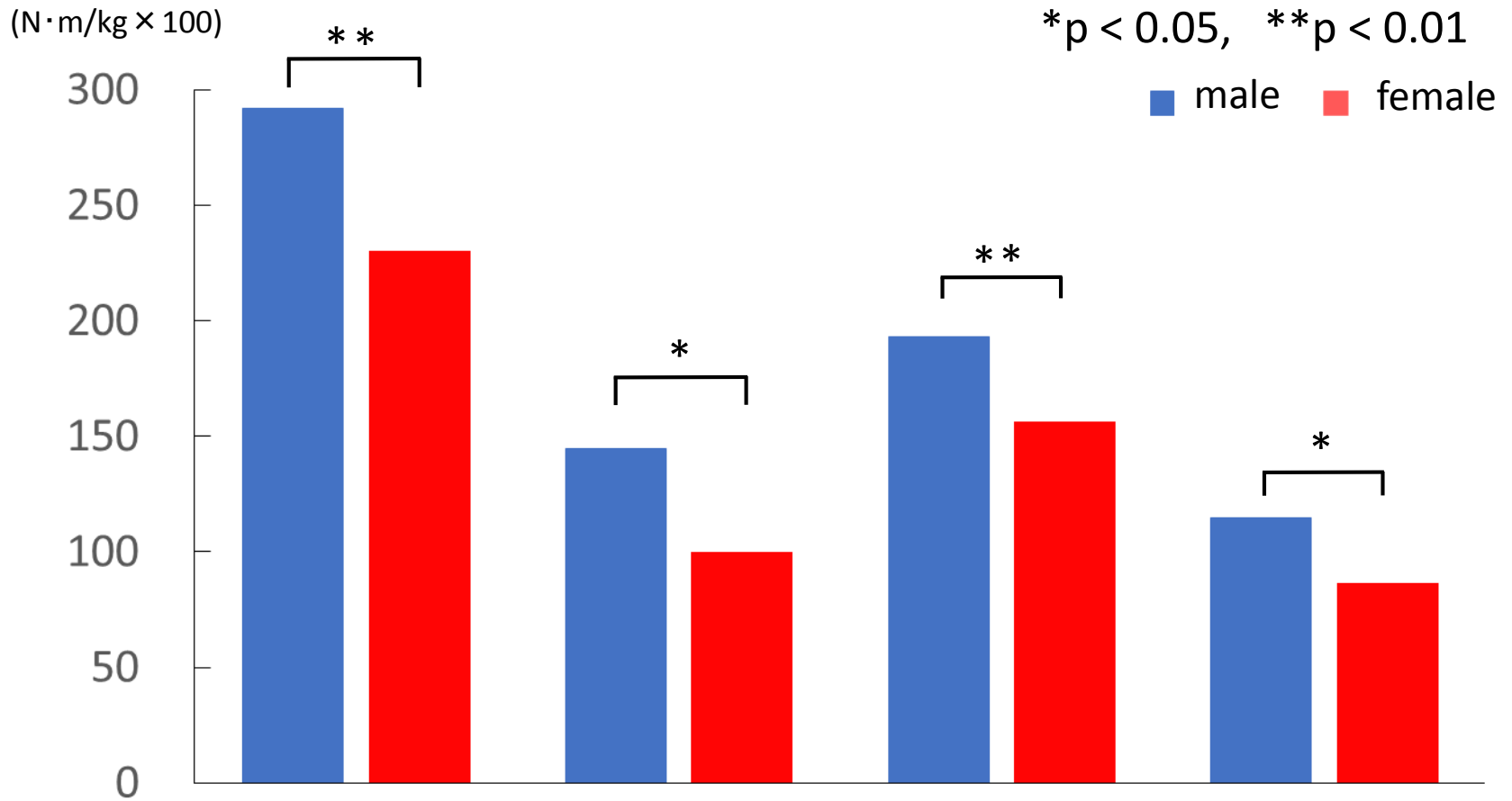
- Tc (contraction time) , Dm (maximal displacement)
- Extensor : Rectus femoris(RF) ,  
Vastus lateralis(VL) , Vastus medialis (VM)
- Flexor : Biceps femoris(BF) , Semitendinosus (ST)

※Anatomical locations of sensor was based on Perotto et al (2005)

# 【Statistics】

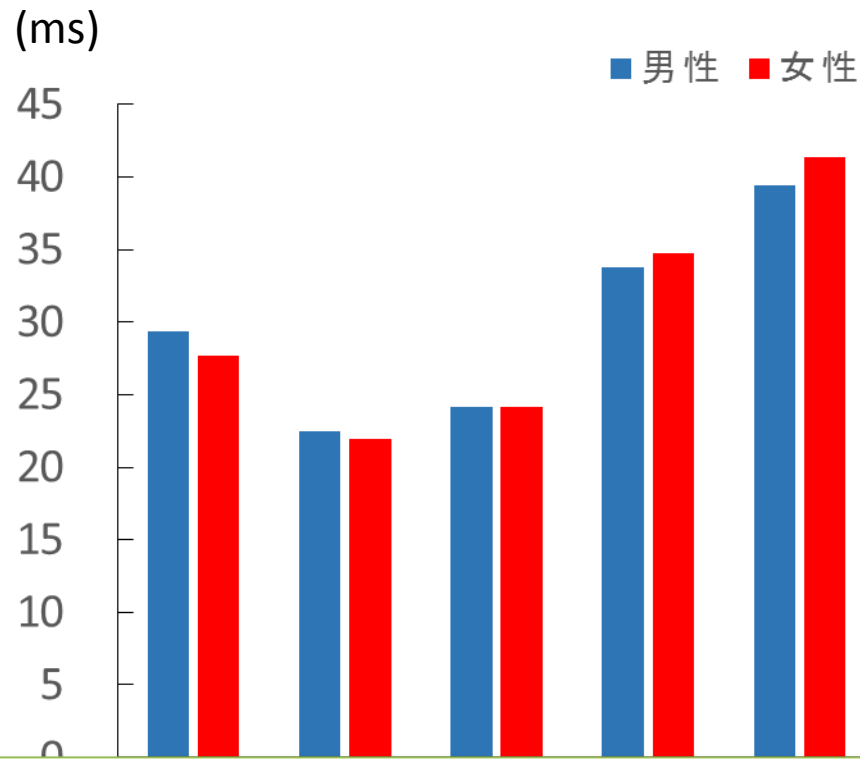
- Male vs Female (knee muscle strength, TMG)
  - ⇒ Unpaired t-test
- Between knee muscle strength and TMG
  - ⇒ Pearson's correlation coefficient
- Significance level was set at  $p < 0.05$

# 【Result】 Isokinetic knee muscle strength

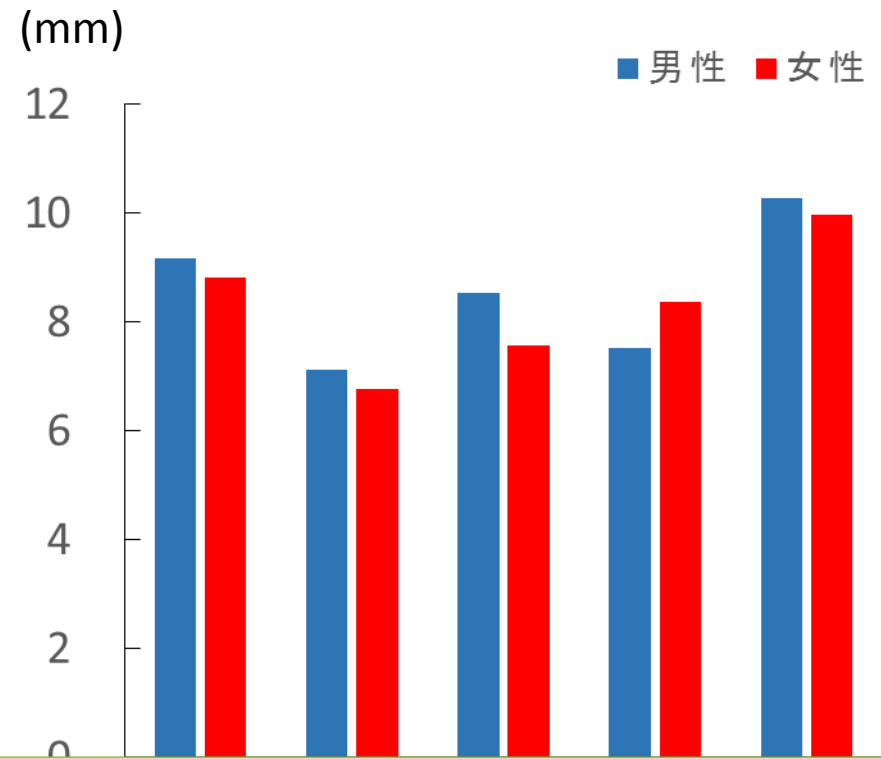


Male showed a significant higher isokinetic knee muscle strength than female

## Tc (Contraction time)



## Dm (Maximal displacement)



There were no significant gender differences in Dm and Tc of each muscles

# Correlation coefficient between knee muscle strength and TMG

## Extensor

	RF		VL		VM		
	Dm	Tc	Dm	Tc	Dm	Tc	
60度/秒	0.16	0.07	0.16	0.02	0.22	0.10	n.s.
180度/秒	0.21	0.19	0.02	0.23	0.33	-0.30	n.s.

## Flexor

	BF		ST		
	Dm	Tc	Dm	Tc	
60度/秒	0.20	0.06	0.27	0.03	n.s.
180度/秒	0.17	-0.12	0.10	-0.22	n.s.

There was no significant correlation of each muscles

# 【Discussion】

- Muscle contraction features by TMG is
- no influence of muscle strength

- ✓ Gender differences in muscle strength per unit of muscle cross-sectional area is not seen (Yamada et al., 1997)
- ✓ The difference in muscle mass due to gender differences of muscle strength of body size difference (Ito, 2002)

High muscle strength ≠ superior contraction features

Low muscle strength ≠ inferior contraction features

Need to focus on muscle contraction features

# 【Limitation】

- ✓ Participant were healthy young people(n=12)
  - ⇒ Not in athletes & patients with variety of disorders
- ✓ Measurement of only one time
  - ⇒ Need to compare between data

How should compare these data?

# 【Future prospects】

## Cohort study

Providing at the same time as the isokinetic muscle strength

## Cross sectional study

- 40 anterior cruciate ligament injuries (Eduard et al., 2014)
- 78 elite soccer players (Rey et al., 2012)

Establishment of the reference value

Quantitative + Qualitative assessment  
⇒ Effective feedback for athletes

# 【Conclusion】

1. To examine the value of TMG as an evaluation equipment, it was confirmed a correlation with the gender differences of isokinetic knee muscle strength and muscle contraction features by TMG.
2. There were no significant gender differences in muscle contraction features by TMG, and no significant correlation with isokinetic knee muscle strength.
3. To establish the TMG as qualitative assessment of muscle, it is necessary to construct the data, including various injuries , sports and competition level.