Preliminary Investigations into Gender Differences in Muscle Contractile Properties

[1]Ashley Jones, [1]Matthew Harrison, [1]Peter Francis and [1]Hannah V. Wilson
[1]Musculoskeletal Health Research Group, School of Clinical and Applied Science, Leeds Beckett University, Leeds, LS13HE, UK.

Introduction & Aims

Tensiomyography (TMG) is used to assess muscle contractile properties via electrical stimulation of superficial muscles and the subsequent displacement of a spring-loaded probe positioned perpendicular to the muscle belly. Probe displacement is indicative of maximal muscle displacement (Dm). Muscle contraction time (Tc) can be estimated from the displacement-time curve and has been validated against muscle fibre type. Males have greater muscle force per kilogram body mass than females when assessed using whole muscle groups via isokinetic dynamometry. Theoretically, these gender differences should also be present in the assessment of muscle displacement. However, on average, females have greater sub-cutaneous fat tissue than males meaning the electrical current must travel further to reach the muscle and the probe may be subject to greater influence from non-contractile tissue between the skin and the muscle. The purpose of this preliminary investigation was to compare skinfold thickness, stimulation amplitude required for Dm and muscle contractile properties between healthy men and women at the gastrocnemius and gluteus maximus muscles.

Methods

Following University ethical approval, 10 men (age: 25.0 ± 2.1 y; height: 177.6 ± 7.5 cm; mass: 84.0 ± 12.7 kg) and 10 women (age: 23.3 ± 2.6 y; height: 166.2 ± 6.7 cm; mass: 62.1 ± 6.3 kg) participated in this study. Skinfold thickness was measured in accordance with the International Society for Anthropometry and Kinesiology guidelines. TMG probe placement was standardised in accordance with published recommendations.[1] An independent samples T-Test and Mann Whitney-U test were used to analyse the data for normal and non-normal data respectively.

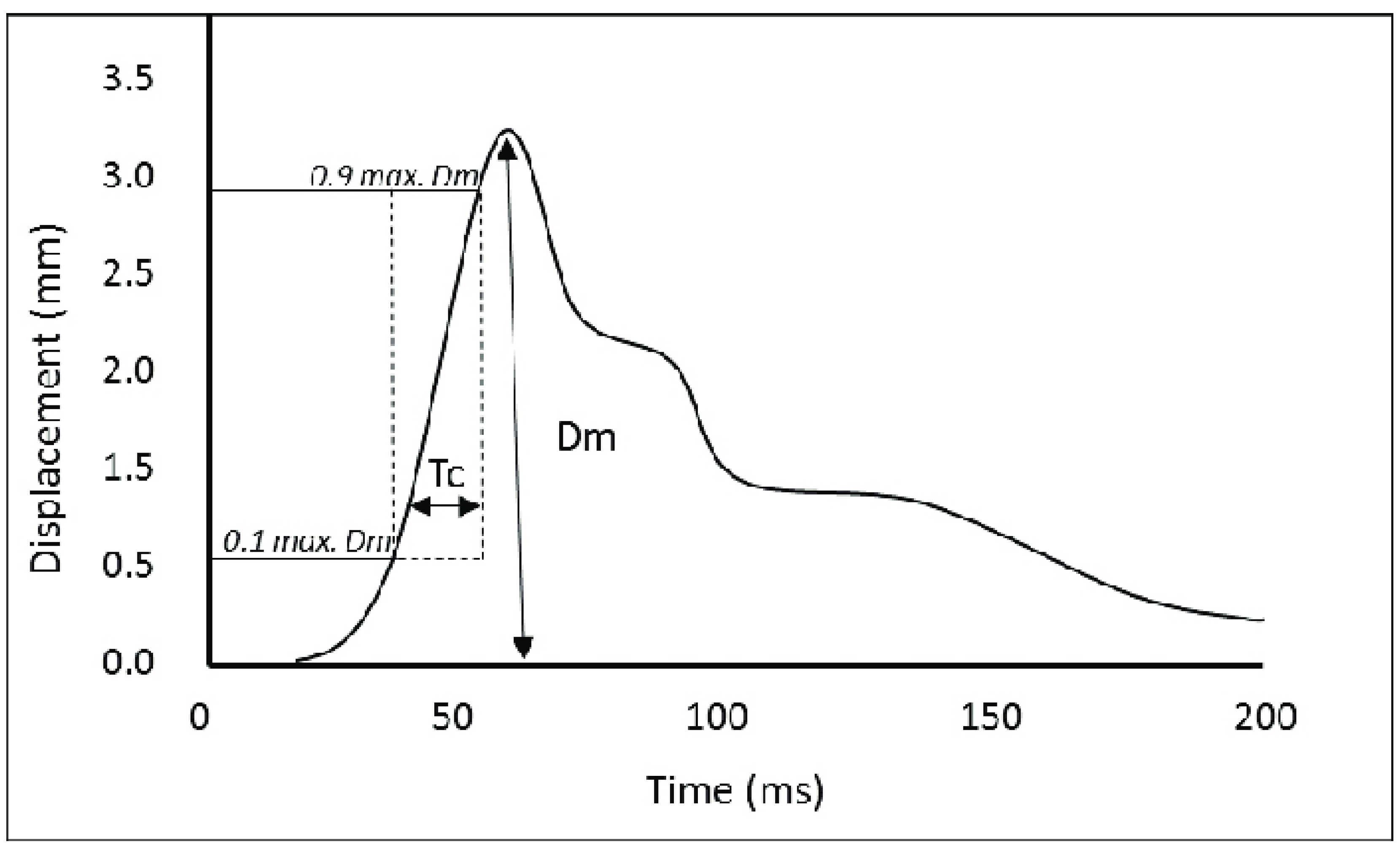

Figure.2 The displacement-time curve

Results

Figure.2 Example TMG Assessment

Table 1. Differences in skinfold thickness, stimulation amplitude and muscle contractile properties between healthy males and females.

Gender	Skinfold; (mm)	Amplitude; (amps)	Muscle Displacement, Dm; (mm)	Contraction Time, Tc; (ms)	Displacement/ Body Mass; (mm/kg)
Gastrocnemius Lateralis					
Male	12.0 (5.8)	61.3 ± 20.7	3.3 (1.5)	22.5 (4.8)	0.04 ± 0.01
Female	15.0 (6.4)	60.3 ± 14.4	5.4 ± 3.8	32.6 (14.9)	0.09 ± 0.06
Difference (p-value)	3.0 (0.190)	1.0 (0.132)	2.1 (0.218)	10.1 (0.393)	0.05 (0.031)
Gluteus Maximus					
Male	20.8 ± 4.5	99.3 (4.9)	7.9 ± 2.9	35.8 ± 6.6	0.10 ± 0.04
Female	23.5 ± 3.0	99.5 (8.0)	7.9 ± 2.9	38.7 ± 5.0	0.13 ± 0.04
Difference (p-value)	2.7 (0.127)	0.2 (0.529)	0.0 (0.963)	2.9 (0.282)	0.03 (0.126)

Values are displayed as mean ± SD; median (IQR). Differences are the result of independent samples t-tests or Mann Whitney U tests for normal and non-normal data respectively.

Skinfold thickness, Dm and Tc were not different between men and women for either the gastrocnemius lateralis or gluteus maximus (*P*>0.05). Dm, corrected for body mass, was greater in women compared to men for the gastrocnemius lateralis (*P*=0.031).

Conclusions

It is likely that this investigation was underpowered to detect change. This is evidenced by a consistent trend toward women having greater skinfold thickness that does not reach statistical significance. Our findings may suggest that a lower body mass rather than a lower Dm is the determining factor for differences seen. Furthermore, it appears that females have greater variance in Dm and Tc data around the mean and median. Future work should be conducted, using a larger sample size, to determine if gender differences can be measured using TMG.

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1. Jones, A.D., Hind, K., Wilson, H., Johnson, M.I. and Francis, P., 2017. A standardised protocol for the assessment of lower limb muscle contractile properties in football players using Tensiomyography. *Advances in Skeletal Muscle Function Assessment*. 1(1), pp.13-17.