

# Centrally-mediated responses to NMES are influenced by muscle group and stimulation parameters

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## Supplementary Information

Supplementary Table 1. Comparison of mean force and discomfort between muscle groups by stimulation frequency.

	PF	KE	EF	P value
Mean force 20 Hz (% MVC)	13.2 ± 3.8	11.9 ± 4.2	12.7 ± 5.4	0.071
Mean force 50 Hz (% MVC)	16.4 ± 7.3 <sup>c</sup>	15.7 ± 10.7 <sup>c</sup>	12.9 ± 4.4 <sup>ab</sup>	0.005
Mean force 100 Hz (% MVC)	19.1 ± 11.3 <sup>bc</sup>	15.8 ± 12.7 <sup>ac</sup>	12.6 ± 8.3 <sup>ab</sup>	<0.001
Mean force 147 Hz (% MVC)	18.1 ± 8.9 <sup>bc</sup>	15.2 ± 10.8 <sup>ac</sup>	12.1 ± 6.1 <sup>ab</sup>	<0.001
Discomfort 20 Hz (VAS)	0.7 ± 0.8 <sup>bc</sup>	1.8 ± 1.2 <sup>ac</sup>	2.9 ± 2.0 <sup>ab</sup>	<0.001
Discomfort 50 Hz (VAS)	0.8 ± 0.7	2.0 ± 1.8	2.9 ± 7.9	0.077
Discomfort 100 Hz (VAS)	1.0 ± 1.0 <sup>bc</sup>	2.3 ± 2.8 <sup>a</sup>	1.8 ± 1.1 <sup>a</sup>	<0.001
Discomfort 147 Hz (VAS)	1.0 ± 0.9 <sup>bc</sup>	2.1 ± 2.0 <sup>ac</sup>	1.7 ± 4.2 <sup>ab</sup>	<0.001

PF: plantar flexors; KE: knee extensors; EF: elbow flexors. a = different from PF, b = different from KE, c = different from EF.

Supplementary Table 2. Comparison of mean force and discomfort between muscle groups by pulse duration

	<b>PF</b>	<b>KE</b>	<b>EF</b>	<b>P value</b>
Mean force 0.2 ms (% MVC)	14.4 ± 8.2	14.1 ± 8.0	12.5 ± 5.6	0.115
Mean force 1 ms (% MVC)	17.6 ± 8.4 <sup>bc</sup>	14.8 ± 11.3 <sup>ac</sup>	12.6 ± 5.7 <sup>ab</sup>	<0.001
Mean force 2 ms (% MVC)	18.1 ± 9.8 <sup>bc</sup>	15.1 ± 12.6 <sup>a</sup>	12.6 ± 6.9 <sup>a</sup>	<0.001
Discomfort 0.2 ms (VAS)	0.6 ± 0.6 <sup>bc</sup>	1.9 ± 2.4 <sup>a</sup>	2.8 ± 6.9 <sup>a</sup>	0.011
Discomfort 1 ms (VAS)	0.9 ± 0.9 <sup>bc</sup>	2.1 ± 1.6 <sup>a</sup>	2.1 ± 1.5 <sup>a</sup>	<0.001
Discomfort 2 ms (VAS)	1.0 ± 0.9 <sup>bc</sup>	2.2 ± 1.8 <sup>a</sup>	2.0 ± 1.5 <sup>a</sup>	<0.001

PF: plantar flexors; KE: knee extensors; EF: elbow flexors. a = different from PF, b = different from KE, c = different from EF.

Supplementary Table 3. Linear mixed model statistics inter-frequency

Fixed effect tests		F	Degrees of freedom	P value
<b>Extra force 20 Hz</b>	<i>Muscle group</i>	0.61	2	0.547
	Pulse duration	1.06	2	0.349
	Muscle group x Pulse duration	0.25	4	0.907
<b>Extra force 50 Hz</b>	<i>Muscle group</i>	1.50	2	0.228
	Pulse duration	3.64	2	<b>0.029</b>
	Muscle group x Pulse duration	1.39	4	0.242
<b>Extra force 100 Hz</b>	<i>Muscle group</i>	0.17	2	0.840
	Pulse duration	10.14	2	<b>&lt; 0.001</b>
	Muscle group x Pulse duration	0.25	4	0.908
<b>Extra force 147 Hz</b>	<i>Muscle group</i>	0.65	2	0.521
	Pulse duration	8.77	2	<b>&lt; 0.001</b>
	Muscle group x Pulse duration	0.507	4	0.731
<b>Sustained EMG activity 20 Hz</b>	<i>Muscle group</i>	1.89	2	0.156
	Pulse duration	7.44	2	<b>&lt; 0.001</b>
	Muscle group x Pulse duration	1.58	4	0.184
<b>Sustained EMG activity 50 Hz</b>	<i>Muscle group</i>	1.13	2	0.325
	Pulse duration	13.25	2	<b>&lt; 0.001</b>
	Muscle group x Pulse duration	0.33	4	0.860
<b>Sustained EMG activity 100 Hz</b>	<i>Muscle group</i>	0.74	2	0.477
	Pulse duration	17.63	2	<b>&lt; 0.001</b>
	Muscle group x Pulse duration	1.06	4	0.377
<b>Sustained EMG activity 147 Hz</b>	<i>Muscle group</i>	1.62	2	0.201
	Pulse duration	14.77	2	<b>&lt; 0.001</b>
	Muscle group x Pulse duration	1.27	4	0.287

<b>Mean force 20 Hz</b>	<i>Muscle group</i>	2.67	2	0.073
	Pulse duration	0.56	2	0.571
	Muscle group x Pulse duration	0.83	4	0.510
<b>Mean force 50 Hz</b>	<i>Muscle group</i>	5.73	2	<b>0.004</b>
	Pulse duration	2.71	2	0.070
	Muscle group x Pulse duration	1.45	4	0.222
<b>Mean force 100 Hz</b>	<i>Muscle group</i>	8.84	2	<b>&lt; 0.001</b>
	Pulse duration	1.68	2	0.190
	Muscle group x Pulse duration	0.60	4	0.663
<b>Mean force 147 Hz</b>	<i>Muscle group</i>	10.29	2	<b>&lt; 0.001</b>
	Pulse duration	0.74	2	0.478
	Muscle group x Pulse duration	0.77	4	0.546
<b>Discomfort 20 Hz</b>	<i>Muscle group</i>	43.99	2	<b>&lt; 0.001</b>
	Pulse duration	0.69	2	0.506
	Muscle group x Pulse duration	0.28	4	0.889
<b>Discomfort 50 Hz</b>	<i>Muscle group</i>	2.58	2	0.080
	Pulse duration	0.27	2	0.761
	Muscle group x Pulse duration	0.99	4	0.416
<b>Discomfort 100 Hz</b>	<i>Muscle group</i>	7.30	2	<b>0.001</b>
	Pulse duration	0.01	2	0.992
	Muscle group x Pulse duration	0.64	4	0.633
<b>Discomfort 147 Hz</b>	<i>Muscle group</i>	16.97	2	<b>&lt; 0.001</b>
	Pulse duration	0.87	2	0.423
	Muscle group x Pulse duration	0.62	4	0.647

Significant p values are displayed in bold.

Supplementary Table 4. Linear mixed model statistics inter-Muscle group

		<b>F</b>	<b>Degrees of freedom</b>	<b>P value</b>
<b>Fixed effect tests</b>				
<b>Extra force 0.2 ms</b>	<i>Muscle group</i>	2.84	2	0.062
	Stim frequency	1.43	3	0.236
	Muscle group x Stim frequency	1.17	6	0.325
<b>Extra force 1 ms</b>	<i>Muscle group</i>	12.07	2	<b>&lt; 0.001</b>
	Stim frequency	1.09	3	0.354
	Muscle group x Stim frequency	1.24	6	0.289
<b>Extra force 2 ms</b>	<i>Muscle group</i>	6.69	2	<b>0.002</b>
	Stim frequency	1.18	3	0.318
	Muscle group x Stim frequency	0.97	6	0.450
<b>Sustained EMG activity 0.2 ms</b>	<i>Muscle group</i>	13.47	2	<b>&lt; 0.001</b>
	Stim frequency	3.87	3	<b>0.010</b>
	Muscle group x Stim frequency	1.32	6	0.250
<b>Sustained EMG activity 1 ms</b>	<i>Muscle group</i>	15.86	2	<b>&lt; 0.001</b>
	Stim frequency	5.23	3	<b>0.002</b>
	Muscle group x Stim frequency	0.86	6	0.523
<b>Sustained EMG activity 2 ms</b>	<i>Muscle group</i>	25.50	2	<b>&lt; 0.001</b>
	Stim frequency	3.21	3	<b>0.025</b>
	Muscle group x Stim frequency	0.95	6	0.461
<b>Mean force 0.2 ms</b>	<i>Muscle group</i>	2.19	2	0.115
	Stim frequency	1.43	3	0.235
	Muscle group x Stim frequency	0.80	6	0.573
<b>Mean force 1 ms</b>	<i>Muscle group</i>	11.84	2	<b>&lt; 0.001</b>
	Stim frequency	4.08	3	<b>0.008</b>
	Muscle group x Stim frequency	1.33	6	0.246

<b>Mean force 2 ms</b>	<i>Muscle group</i>	9.88	2	<b>&lt; 0.001</b>
	Stim frequency	3.17	3	<b>0.026</b>
	Muscle group x Stim frequency	1.36	6	0.235
<b>Discomfort 0.2 ms</b>	<i>Muscle group</i>	4.57	2	<b>0.012</b>
	Stim frequency	0.42	3	0.739
	Muscle group x Stim frequency	0.99	6	0.433
<b>Discomfort 1 ms</b>	<i>Muscle group</i>	23.98	2	<b>&lt; 0.001</b>
	Stim frequency	0.44	3	0.724
	Muscle group x Stim frequency	2.21	6	<b>0.045</b>
<b>Discomfort 2 ms</b>	<i>Muscle group</i>	17.56	2	<b>&lt; 0.001</b>
	Stim frequency	0.362	3	0.780
	Muscle group x Stim frequency	2.58	6	<b>0.020</b>

Significant p values are displayed in bold.