

Effects of a high-frequency microfocal vibratory stimulation on the H reflex of the soleus muscle. A double-blind study in healthy subjects

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INTRODUCTION

Equistasi® is a small vibro-tactile device (1 cm²) based on nanotechnology. It converts body temperature into a mechanical focal vibration with a frequency of about 9000 Hz. It is known that a tonic vibratory stimulus (TVS) of the muscle tendon modulates proprioceptive afferents and reduces the amplitude of the H reflex in humans.

The aim of our study is to explore the effects of Equistasi® on motoneuron excitability and on proprioceptive reflex pathways in healthy subjects.

MATERIALS AND METHODS

Subjects

We examined 19 healthy subjects (9 males), aged 28.4 ± 7.9 years.

H reflex

The H reflex was recorded from the soleus. The tibial nerve was stimulated at the popliteal fossa with percutaneous bipolar electrodes.

The TVS was delivered applying a vibrator (monophasic rectangular pulses, 2 ms, 100 Hz) over the Achilles tendon for 100 seconds.

We examined the ratio between the maximum H reflex before TVS (H1) and the maximum M (Mmax) of the soleus muscle (H1/Mmax).

To evaluate the effects of TVS, the H reflex was examined before TVS (H1) and during TVS (H2). A “vibratory index” (VI) was calculated using the following formula: (H2/H1)x100. Three minutes after TVS, H maximum response (H3) was recorded in order to investigate the late-effects. A H3/Mmax response and a “vibratory index late effect” were also calculated (VI late = (H2/H3)x100).

Electrophysiological investigations were performed twice in all subjects: before applying Equistasi® (T₀) and while wearing it or Placebo (T₁) over the calcaneal tendon.

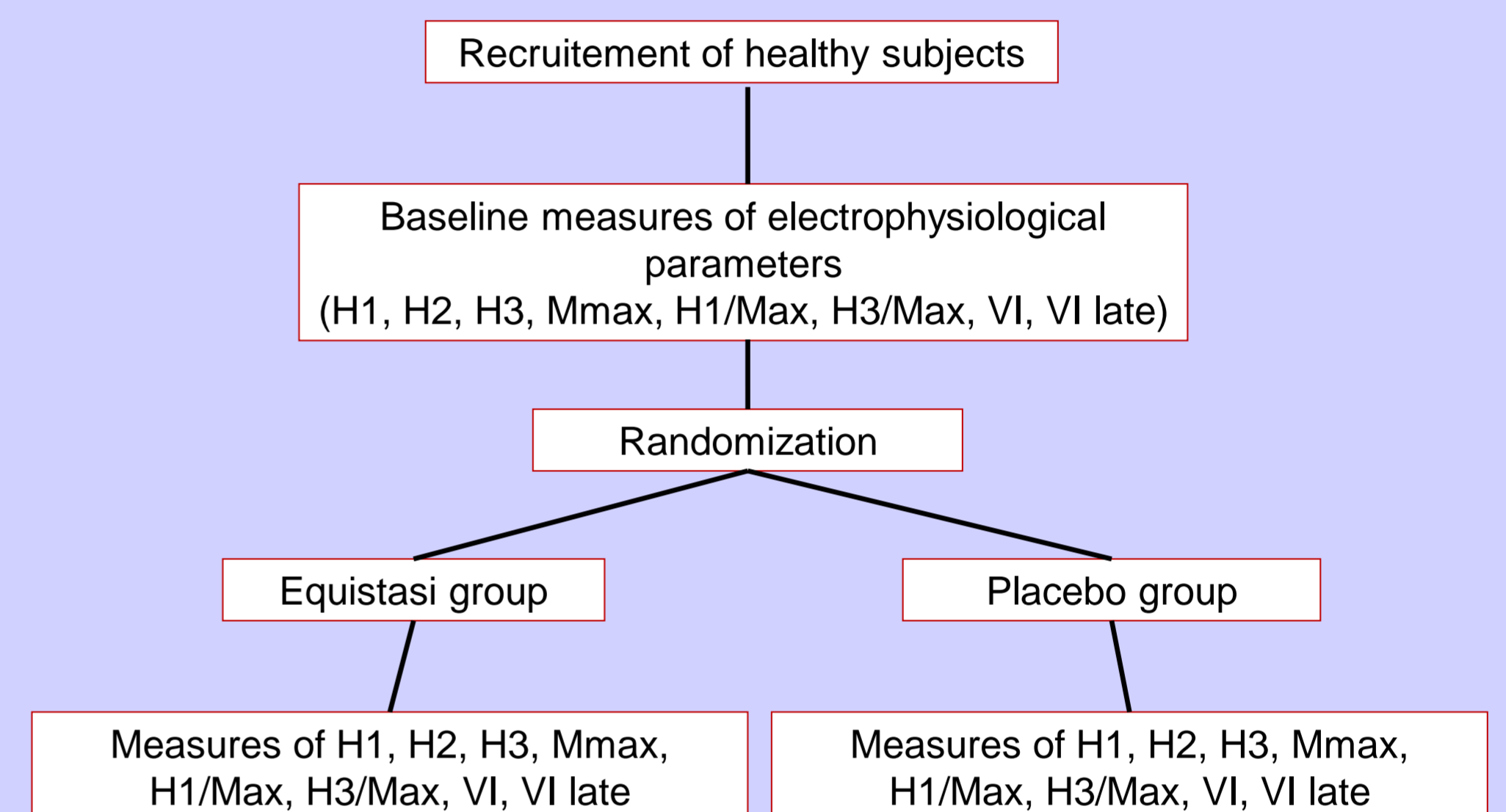


Figure 1 – Study design

	T0	T1	p-value
H1 (mA)	9.29±4.01	8.7±4.7	ns
H2 (mA)	1.3±2.52	0.83±2.34	0.025
H3 (mA)	8.77±4.04	7.64±4.27	0.017
Mmax (mA)	18.26±5.98	18.8±6.04	ns
H1/Mmax	0.49±0.16	0.44±0.19	ns
H3/Mmax	0.47±0.19	0.40±0.19	0.016
VI	9.51±15.85	4.79±12.80	0.006
VI late	10.33±17.40	5.65±14.81	0.01

Table I – Values of EMG parameters in the Equistasi group (data are presented as means ± sd)

	T0	T1	p-value
H1 (mA)	9.21±5.34	8.38±5.25	ns
H2 (mA)	1.61±2.01	1.24±1.69	ns
H3 (mA)	8.70±5.07	8.01±5.18	ns
Mmax (mA)	17.32±5.71	17.49±5.45	ns
H1/Mmax	0.53±0.24	0.49±0.26	ns
H3/Mmax	0.50±0.24	0.48±0.28	ns
VI	12.95±12.87	10.50±10.31	ns
VI late	13.49±13.55	10.84±10.36	ns

Table II – Values of EMG parameters in the Placebo group (data are presented as means ± sd)

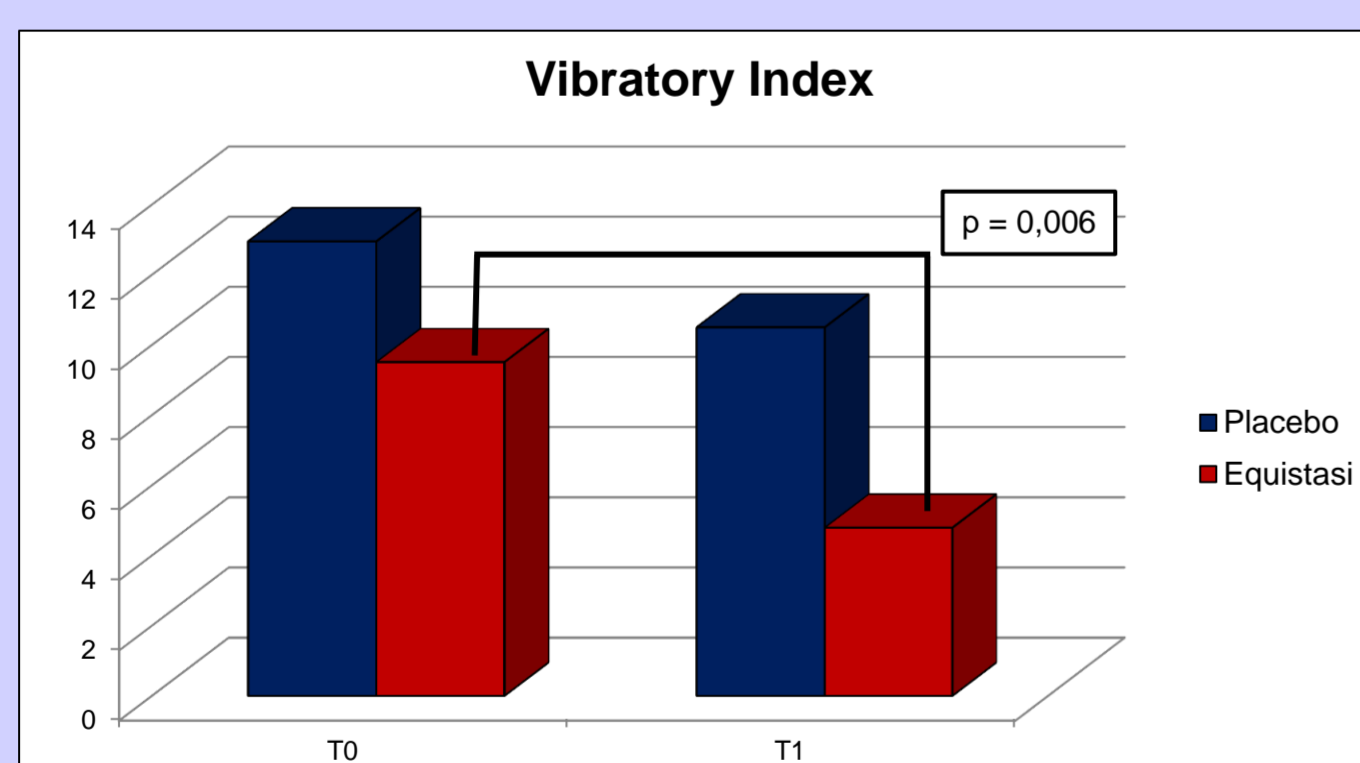


Figure 2 – Vibratory Index

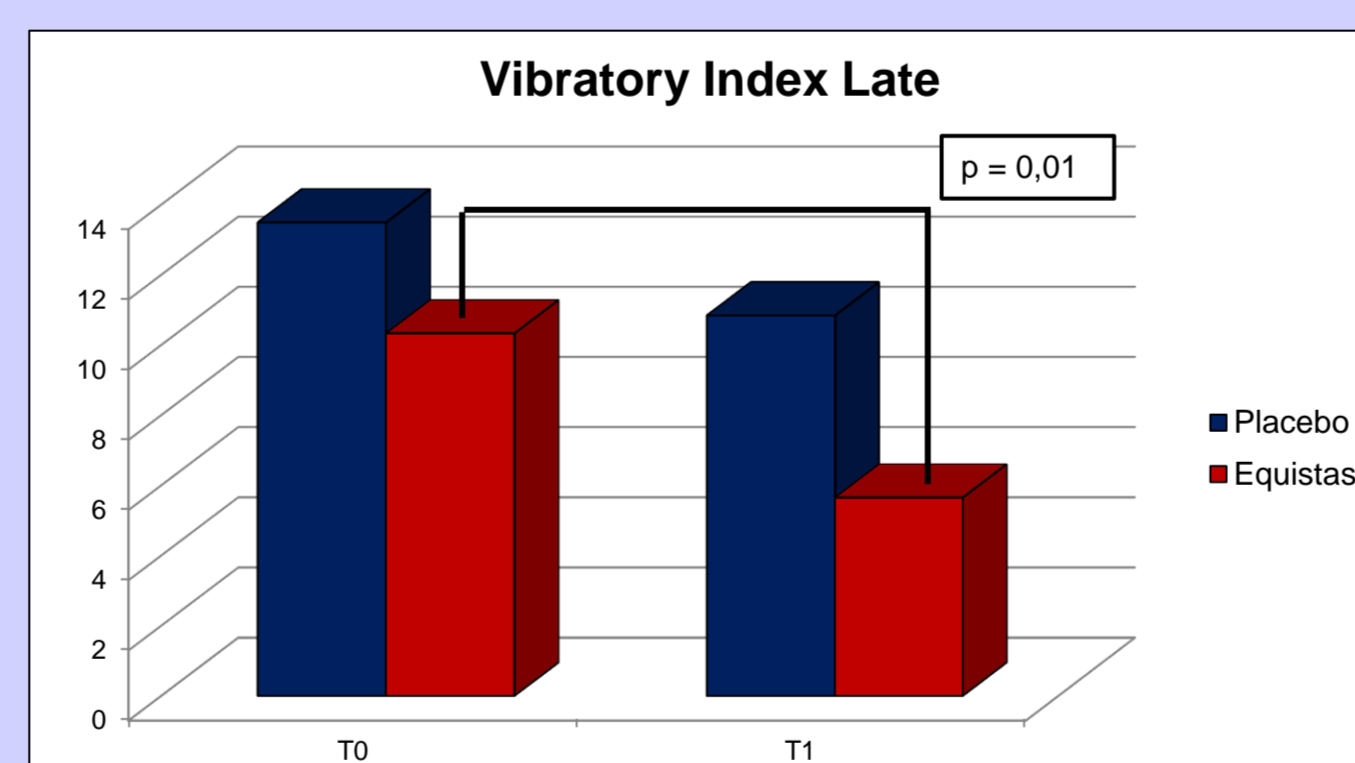


Figure 3 – Vibratory Index Late

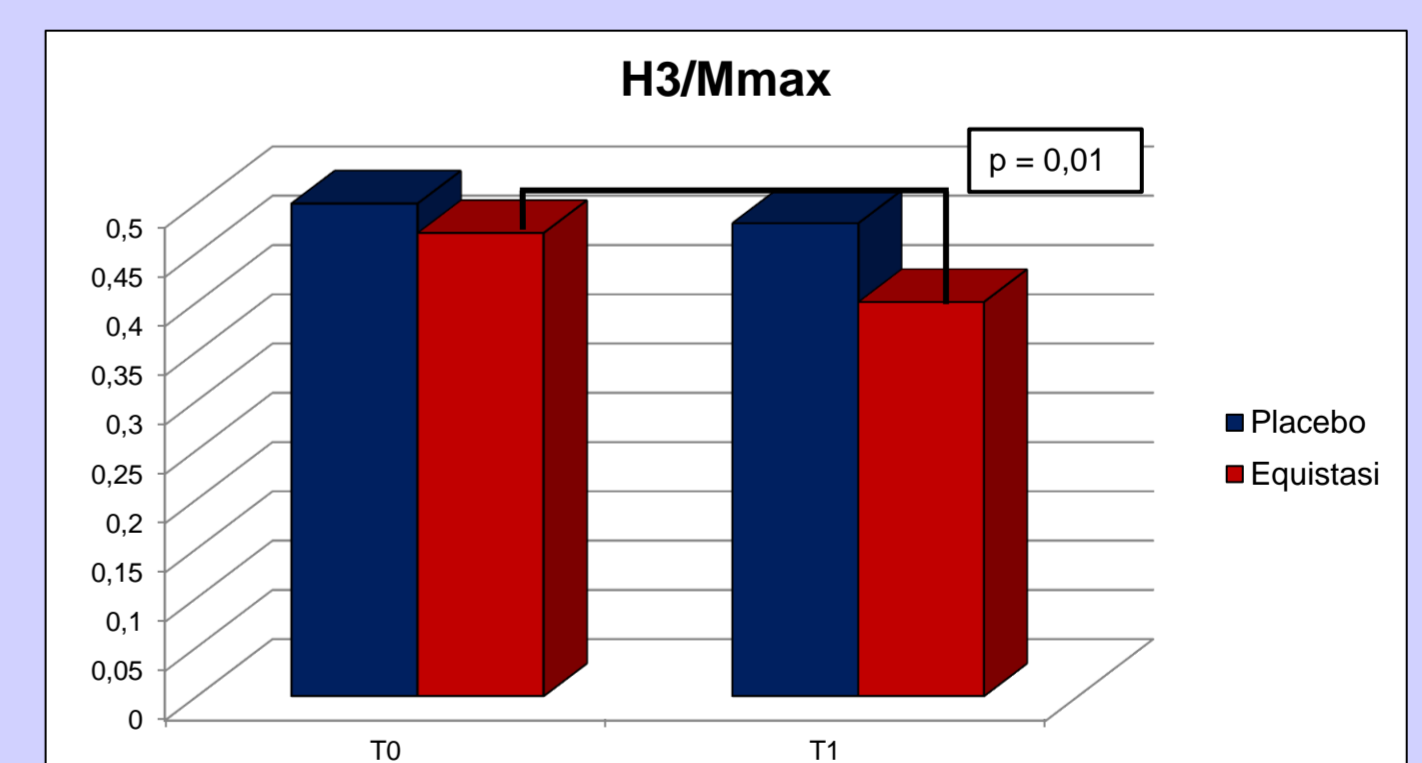


Figure 4 – H3/Mmax

RESULTS

The electrophysiological parameters are shown in Table I and Table II.

Intragroup comparisons

At T₁ in the Equistasi® Group both VI and VI late were significantly lower as compared to T₀ (Figures 2 and 3). Furthermore, we found that the decrease of maximum H amplitude was statistically significant respect to T₀ at the end of TVS (H2), persisting for 3 more minutes (H3). In addition, H3/Mmax value at T₁ was lower than the H3/Mmax value obtained at T₀ (Figure 4).

In the Placebo Group we did not detect any significant difference in any parameter between T₀ and T₁.

Equistasi® group vs Placebo group

At T₁, the decrease induced by TVS was more marked in the Equistasi® group as compared to the Placebo group as suggested by the significant reduction in both VI and VI Late in this group only (figures 2 and 3).

Similarly, H3/Max in Equistasi® group was significantly lower than that obtained in Placebo group (Figure 4).

CONCLUSION

We confirmed how the application of a vibratory stimulation on a muscle tendon is able to modulate the Ia proprioceptive afferents. Equistasi® increases the H-reflex inhibition produced by TVS, and reduces alpha motor neuron excitability. Further studies are needed to assess the efficacy of Equistasi® on muscular strength and fatigue and as a wearable stabilizer for balance and postural abnormalities in motor disorders.