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)×100. 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)×100).

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

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/Mmax 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.