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Acute Effects of Stochastic and Sinusoidal Whole Body Vibration On Pelvic Floor Muscle Activation

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Hypothesis / aims of study:
Women after vaginal delivery are often suffering from pelvic floor muscle disorders and urinary incontinence. Physiotherapy and particularly pelvic floor muscle training has already been established (1). Additionally the positive effects of whole body vibration training on power and strength of skeletal muscles of the lower limb have been shown (2,3,4). However the influence of whole body vibration training on pelvic floor muscle activation has not yet been examined. This study investigated the effect of whole body vibration treatment on the activity of pelvic floor muscles at various vibration intensities and on two different vibration devices: one with stochastic resonance vibrations (SR) and another with sinusoidal vibrations (SV).

Study design / materials and methods:
22 healthy women (30.0 ±4.7 years, 1.66±0.056 m, 59.6±7.6 kg) and 18 subjects post partum (31.7 ±3.4 years, 1.70±0.067 m, 66.4.6±7.7 kg) participated in this prospective cross sectional study. Initially the maximum isometric voluntary contraction (MVC) of pelvic floor muscles was measured by electro-myo-graphy (EMG). Afterwards, pelvic floor activity at six different intensities was measured on the two different vibration platforms (SR at 2, 4, 6, 8, 10 and 12Hz; SV at 5Hz 2mm, 5Hz 4mm, 15Hz 2mm, 15Hz 4mm, 25Hz 2mm and 25Hz 4mm). At each intensity EMG-data were collected during vibration (VIB) and during vibration combined with MVC (VIB+MVC). The order of vibration devices and the six intensities was randomised. Tests for SR and SV started at two different days.
Vibration artefacts in the EMG raw signal were removed by notch filtering. EMG was calculated with RMS-algorithm and was MVC-normalized (MVC=100 EMG%). Descriptive statistics, differences between the six dependent intensities (Friedman's ANOVA), differences between groups (Mann-Withney-U) and differences between devices (Wilcoxon) were calculated with SPSS. The current study was approved by the local Ethical Committee and patients gave informed consent.

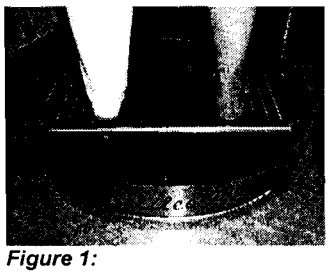

Figure 1:
Galileo 900 with sinusoidal vibration

Figure 2:
Zeptor with stochastic resonance vibration

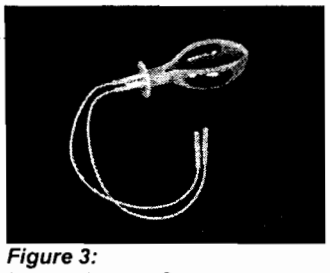

Figure 3:
Intravaginal EMG sensor

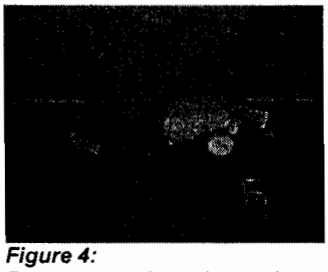

Figure 4:
Rest measure in supine position

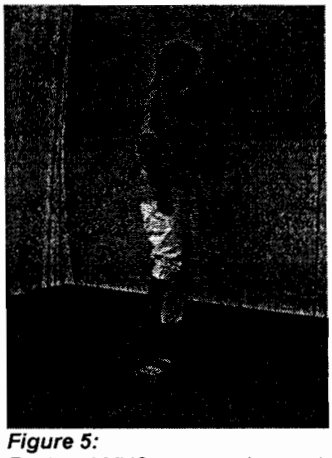

Figure 5:
Rest and MVC measure in stands position

Results:
There was a significant increase of muscular activation during VIB with increasing vibration intensities on each vibration device and for each group (all: $p<0.001$). During VIB+MVC only the stochastic vibrations showed a significant increase with increasing intensity ($p<0.001$) for both groups.
For subjects post partum especially the stochastic vibration lead to peak activation higher than MVC (12Hz=126.7 EMG%). Peak values at sinusoidal vibration reached a significant lower activation (25Hz 4mm = 73.0 EMG%) (ε= 0.796; Power=0.889).
The post partum group showed a substantial peak effect during SR (VIB+MVC: 12Hz=163.9 EMG%), in contrast the SV caused a significant lower activation (VIB+MVC: 25Hz 4mm=104.6 EMG%) (ε= 0.999; Power=0.979).

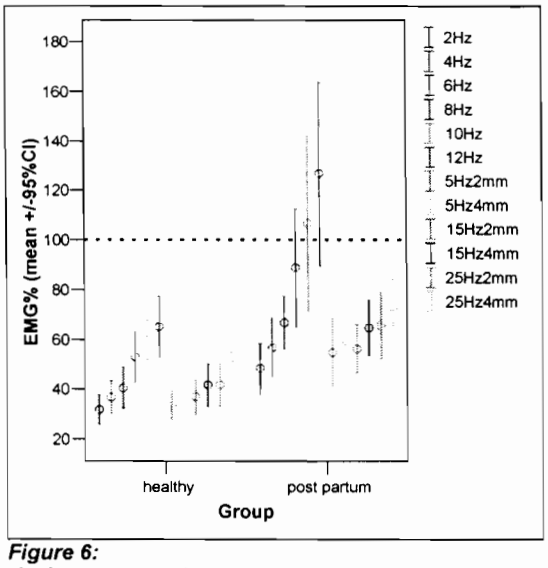

Figure 6:
EMG during vibration only

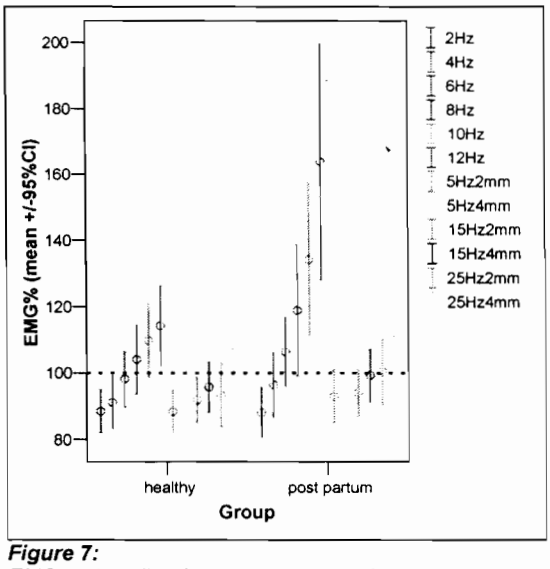

Figure 7:
EMG during vibration and maximal voluntary contraction

Interpretation of results: Various neurobiological and therapeutic surveys showed higher sensitivity and outcome concerning the human nervous system or muscular system to stochastic resonance vibratory stimuli compared to sinusoidal vibrations (5,6). The advantage for stochastic vibration concerning reactivity of pelvic floor muscles was also found in this study. A typical clinical finding in patients with stress urinary incontinence is the absence of a strong and powerful reactive contraction of the pelvic floor during impact strain. The stochastic resonance therapy has the potential to improve the rate of force development and the reactive activity of pelvic floor muscles with a significantly higher intensity than maximum isometric voluntary contraction.

Concluding message: The specific use of stochastic resonance vibratory stimuli could be meaningful in developing sensorimotor abilities, power and maximum strength of the pelvic floor muscles in addition to other pelvic floor re-education strategies in physiotherapy.

References:

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