Effect of Remote Subthreshold Vibrotactile Noise on Hand Function Post-Stroke

Marcella Kosmopoulos, Pilwon Hur, Leah Enders, Na Jin Seo

Current stroke hand rehabilitation focuses on movement repetitions, rather than starting from sensory rehabilitation to facilitate motor recovery, when sensory feedback is a prerequisite for fine motor control of the hand. Currently, there is not a single medical device in use that enhances patients' tactile sensation to improve hand motor function. Our recent work showed that stroke survivors' finger tactile sensation can improve with application of subthreshold vibrotactile noise at the wrist, remotely from the fingers (Enders et al. 2013). It is unknown if this improved tactile sensation directly leads to enhanced hand motor function in stroke survivors. The objective of this study was to evaluate the effectiveness of the remote subthreshold vibrotactile noise in improving hand motor function for stroke survivors with sensorimotor deficit.

Hand motor function was compared with vs. without remote subthreshold vibrotactile noise in ten chronic stroke survivors with mild to moderate sensory and motor deficits. Vibrotactile noise was applied to the dorsal and volar wrist at the intensity of 60% of the sensory threshold using C-3 Tactors. Hand motor function was assessed using the Box and Block Test (BBT), Nine-Hole Peg Test (NHPT), and pinch grip strength. To account for learning effects, practice was given before testing, and the hand motor function scores without the remote subthreshold vibrotactile noise were obtained at the beginning and at the end, while those with the remote subthreshold vibrotactile noise were obtained in the middle of the testing.

The results showed that remote subthreshold vibrotactile noise significantly improved hand motor function for stroke survivors with sensorimotor deficit: With the remote subthreshold vibrotactile noise, subjects moved significantly more number of blocks in BBT by 3% (p=0.027 in repeated measures ANOVA); completed the NHPT significantly faster by 13% (p=0.008); and significantly increased pinch grip strength by 9% (p=0.036).

In summary, hand motor function improved with the remote subthreshold vibrotactile noise for chronic stroke survivors with mild to moderate sensory and motor deficits. This study suggests potential in developing an assistive device applying remote subthreshold vibrotactile noise to enhance hand sensorimotor function. The remote effect (affecting hand/finger function with vibrotactile noise applied at the wrist) allows the assistive device to stay away from the fingers so as not to interfere with object manipulation and dexterous hand function. Such an assistive device may complement hand rehabilitation for stroke survivors with sensorimotor deficit, and thus, lead to enhanced quality of life.

Reference:

Enders LR, Hur P, Johnson MJ, and Seo NJ. Remote vibrotactile noise improves light touch sensation in stroke survivors' fingertips via stochastic resonance. *J Neuroeng Rehabil* 10: 105, 2013.

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