The effects of skin and muscle targeted vibration stimuli on the flexion relaxation phenomenon

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Summary

The flexion relaxation phenomenon (FRP) occurs when paraspinal muscle activity is reduced at end-range trunk forward flexion. This study investigated the utility of administering vibrotactile feedback to alter the timing and magnitude of the FRP. Surface EMG of the trunk extensors and gross lumbar spine angle were measured during full spine flexion in three conditions: baseline, and with two vibration stimuli to target skin or muscle mechanoreceptors. Preliminary results suggest vibrotactile feedback does not affect the timing of the FRP. This research helps to improve our understanding of the sensory contributions to the FRP which is commonly observed at end-range spine flexion.

Introduction

The flexion relaxation phenomenon (FRP) occurs when paraspinal muscle activity is reduced at end-range trunk forward flexion [1]. FRP occurs in healthy individuals; however, this is notably absent in those experiencing chronic pain [2,3]. It has been suggested that there is potential for this phenomenon to be manipulated by changes in task mechanics, as previous work has noted that less lumbar flexion is required when the external moment is reduced to induce FRP [3]. However, what remains poorly understood is how the body perceives the necessitated muscle mediated torque required from the paraspinal muscles, and if peripheral mechanoreceptor (in)sensitivity is a potential contributing factor to the absence of the FRP in those with chronic pain. The ***purpose*** of this study is to quantify the response to supplementary vibrotactile feedback on the timing and magnitude of the FRP in young healthy individuals. It was ***hypothesized*** that the use of vibrotactile stimuli will induce earlier onset of FRP, with greater effects seen when targeting muscle receptors.

Methods

17 healthy young participants have participated in this study thus far (10M/7F, 23±2.3 yrs, 173.7±7.4 cm, 75.4±13.9 kg). Participants were instrumented with surface EMG (Noraxon, Ultium, fs=2000Hz) on the trunk extensors (thoracic erector spinae[T9], lumbar erector spinae[L3]). Gross lumbar spine flexion angles were measured with two rigid bodies affixed at the T12 and S1 levels (8x Vicon Vero, fs=100Hz). Participants completed three full spinal flexions in standing in three randomized conditions: (1) BASELINE (no stimulus), (2) VIB1 (high frequency, low amplitude vibrotactile stimulus), and (3) VIB2 (low frequency, high amplitude vibrotactile stimulus). VIB1 vibration parameters were: 250Hz, 0.2mm (EAI, C2), and VIB2 vibration parameters were: 70Hz, 2mm (EAI, EMS2). The vibrotactile stimuli were applied at the paraspinals and chosen to preferentially target either skin (VIB1) or muscle (VIB2) mechanoreceptors.

Results and Discussion

Muscle onset and offset timing relative to the lumbar flexion range of motion were visually detected by two researchers (AB, DSB), and subsequently averaged. There were no statistically significant main effects for the VIB conditions for the onset and offset timings of the lumbar erector spinae muscle group relative to baseline ($\alpha = 0.05$; EccON: p=0.65; EccOFF: p=0.98; ConON: p=0.91; ConOFF: p=0.46).

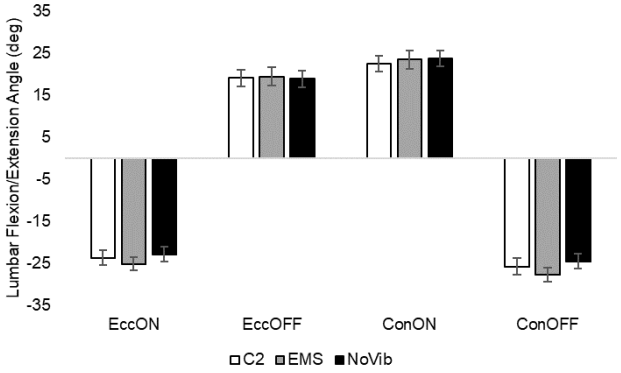

Figure 1: Lumbar erector spinae EMG activity timing relative to the lumbar flexion angle at each condition.

Conclusions

These preliminary data suggest that there may be limited effects of vibrotactile stimulation on the onset and offset of paraspinal muscle activation during the FRP in healthy young individuals, regardless of the type of mechanoreceptor (i.e., VIB1 vs. VIB2). Further research is necessary to assess the potential utility of this feedback type in a clinical population, or those who are currently experiencing pain.

Acknowledgments

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References

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