UNIVERSITY OF BIRMINGHAM | CENTRE OF PRECISION REHABILITATION FOR SPINAL PAIN

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TRUNK CONTROL IN PEOPLE WITH LOW BACK PAIN: THE IMPORTANCE OF MUSCLE SPINDLES INPUT ORIGINATING FROM THE ERECTOR SPINAE

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Introduction

- **Adaptations in lumbar sensory-motor control relate to the evolution of Low Back Pain (LBP) [1].**
- **Factors influencing the lumbar motor output have been extensively studied, while less attention has been given to the possibly compromised lumbar proprioceptive input leading to a loss of trunk control and contributing to LBP chronification [2].**
- **Muscle spindles represent the main proprioceptive receptors and its dominant kinestetic role can be highlighted by the illusion of limb movement induced by muscular vibration [3].**

Aim

- **Examine the contribution of the lumbar muscle spindles on trunk control in LBP versus asymptomatic control (Control), measuring the trunk repositioning error with and without vibration of the lumbar portion of the erector spinae.**

Methods

- **Fifteen Control (age: 29.8 ± 4.1 years) and fifteen LBP (age: 34.7 ± 5.9 years, average pain: 5.7 ± 2.1/10 see Table 1) participated.**
- **An inertial motion sensor attached to the 3rd thoracic spinous process measured the accuracy in adopting and returning to a trunk neutral position after a sagittal movement (50 deg flexion).**
- **Lumbar vibration was randomly applied during trials using the Vibra 3.0 device (Fig. 1- www.vibra-system.com). Three trials were executed for each condition (Vibration, No Vibration).**
- **The mean trunk repositioning error (TRE) was calculated and statistically evaluated using a repeated-measure analysis of variance (ANOVA) within the two vibration conditions.**

Questionnaire or pain intensity outcome	Mean ± SD
Average pain of the most recent episode (VAS-10)	5.7 ± 2.1
Actual Pain (VAS-10)	2.1 ± 1.6
Last 24 hours Pain average (VAS-10)	2.3 ± 1.8
Worst pain previous month (VAS-10)	5.2 ± 2.7
Oswestry Low Back Pain Disability (%)	10.8 ± 6.7
Fear-avoidance beliefs about work (max-42)	9.1 ± 8.1
Fear-avoidance beliefs about physical activity (max-24)	13.5 ± 4.4

Table 1. Mean ± Standard Deviation (SD) of the Questionnaires outcomes administered to the LBP participants at the beginning of the acquisition session.

Figure 1. Vibra 3.0 system generating mechanical-sound waves stimuli able to deliver a controlled vibratory stimulation to muscles beneath the application cup (lower left corner in-picture)

Results

- **Vibration significantly increased TRE in the LBP group (F(1,12)=7.221, P=0.02) but had no significant effect on the control group (F(1,14) =0.985, P=0.34) (Fig.2).**
- **See Table 2 for the Average and Mean Standard Error (SE) of the TRE, graphically reported in Figure 1.**

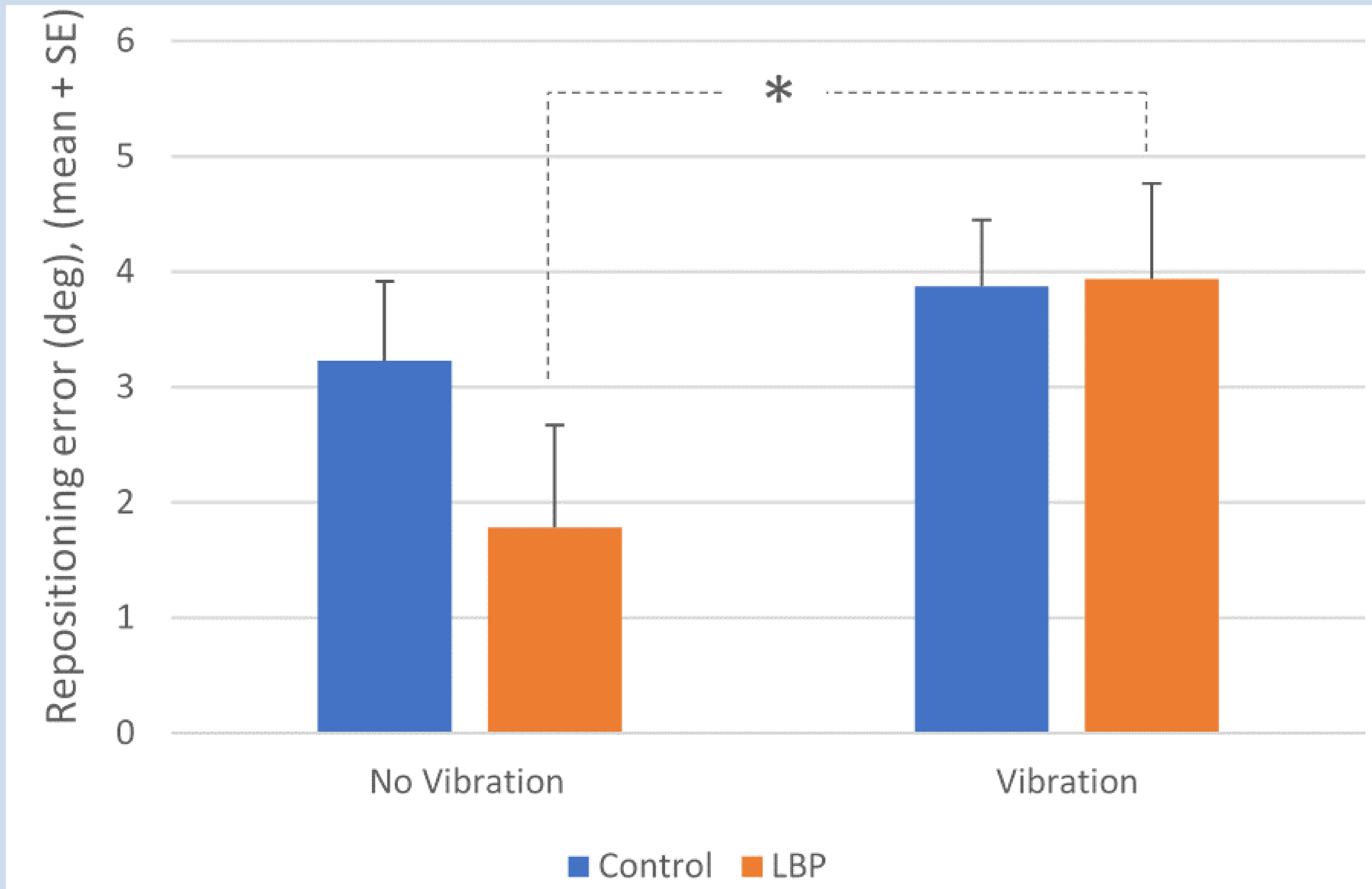

Figure 2. Mean and Mean Standard Error (SE) of the Trunk Repositioning Error (TRE, in deg). Vibration and No Vibration conditions (right and left half, respectively) are reported for both Control and LBP group (blue and orange, respectively). Statistical significance reported by the asterisk ($p < 0.05$)

(Mean ± SE)	No vibration (deg)	Vibration (deg)	p value
LBP	1.8 ± 0.9	3.9 ± 0.8	0.02
Control	3.2 ± 0.7	3.9 ± 0.6	0.34

Table 2. Mean and Mean Standard Error (SE) of the Trunk Repositioning Error (TRE, in deg) and statistical comparisons.

Discussion

- **The increased muscle spindles input caused by vibration, giving an illusion of muscles lengthening, resulted in an increased TRE and overestimation of the neutral trunk position (excessive trunk extension).**
- **The results show that people with LBP are unable to compensate, as happens in the Control group, such paradoxical proprioceptive input exploiting other available sensory information.**
- **This study highlights the pivotal importance of lumbar muscle spindles in controlling trunk motion accuracy.**

References

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