Spatial distribution of erector spinae activity in people with low back pain during a dynamic lifting task

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Previous studies utilising high-density electromyography (HDEMG) have revealed subtle differences in the distribution of the superficial lumbar paraspinal muscle activity during both static and dynamic tasks in people with LBP. In the current study, we extend this work by uniquely evaluating the effect of chronic LBP on the spatial distribution of activity in both the thoracolumbar and lumbar erector spinae (ES) activity during a dynamic lifting task.

Ethical approval was granted from the University of Birmingham. Eleven LBP (5 men; 32.5±16.3years) and fourteen control (CON) participants (6 men; 27.7±11.4years) completed this study. HDEMG was acquired from the ES using four 64-channel (13x8) semi-disposable HDEMG grids (two grids bilaterally) placed over the lumbar and thoracolumbar ES. The spatial distribution of muscle activity was quantified as the centre of activity in the cranio-caudal axis (centroid); and the homogeny of signals (entropy). Reflective kinematic surface markers were placed over the trunk to track spinal kinematics. The dynamic task involved lifting a 5kg weighted box between two anterior shelves at knee and sternum height.

No differences in spinal kinematics were identified between groups ($P>0.05$) reflecting the standardised nature of the task. For both lifting and lowering movements, the distribution of ES activity was centred in a more cranial position ($P<0.05$). For the lifting phase, the mean LBP centroid was 82±5mm cranial to the base of the electrode grids whereas for the CON group the centroid was 78±8mm. For the lowering phase, the centroid was positioned 84±9mm in the cranial direction for the LBP group and 78±8mm for the CON. Additionally, LBP participants displayed a less even spatial distribution of ES activity throughout the task, reflected as systematically lower entropy ($p<0.05$).

These findings indicate that people with LBP engage more cranial regions of the ES during lifting, likely reflecting a less biomechanically favourable motor strategy.

Poster

Introduction

- Low back pain (LBP) is known to be a leading global cause of disability, limiting activity in 540M people at any one time (1).
- High-density electromyography (HDEMG) allows subtle differences in muscle activity caused by LBP to be identified (2-4).
- Lifting studies in LBP populations have previously identified reduced variation in the centre in the muscle activity during repeated lifting (2).
- However previous studies have only considered repeated movements and only recorded activity from a small region of the erector spinae (ES) muscle

Aims and Objectives

- To investigate differences in muscle activity and movement in individuals with LBP during a singular monoplanar lifting task.

Methodology

- 14 control (CON) (Age 27.4 ±11.4) and 11 low back pain (LBP) (Age 32.5 ±16.2) participants were recruited for this study.
- Four semi-disposable HDEMG grids (13x5; OT Bioelettronica) were adhered to participants lumbar and thoracolumbar paraspinal regions (2 grids bilaterally, Figure 1A)
- Triangular arrangements of reflective marks were placed on landmarks across the back to allow for segmental kinematic analysis (BTS Smart) (Figure 1B)
- To complete the task participants lifted a 5kg weighted box from an anterior shelf at knee height, to a shelf at sternal height to the beat of a metronome and rested for 2s before completing the movement in reverse.
- Muscle activity and 3D motion were recorded simultaneously throughout the task

Results

- No differences in spinal kinematics were identified between groups ($P>0.05$; Figure 2)
- LBP participants had a systematically more cranial centre of muscle activity ($P>0.05$; Figure 3) and consistently lower overall levels of muscle activity ($P<0.05$)
- These differences were reflected in homogeny of the signal, with the LBP group demonstrating systematically lower entropy, a result reflected in the spatial distribution of activity (Figure 3)

Discussion

From these results, it appears that LBP participants favour a motor control strategy which places an emphasis on the more cranial regions of the ES.

Activation in the more cranial lumbar and thoracolumbar regions of the ES is likely to cause a less biomechanically favourable contraction (5)

Additionally, the LBP group was shown to experience a more heterogeneous contraction of the ES, indicating that the load was more concentrated across less of the muscle.

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