Title

How does LBP Influence Muscle Activity during a Cyclical Dynamic Lifting Task?

Authors

Andy Sanderson, Corrado Cescon, Nicola R. Heneghan, Alison Rushton, Marco Barbero, Pauline Kuithan, Deborah Falla

Purpose

Chronic non-specific low back pain (cLBP) is a leading cause of disability, limiting activity in 540 million people globally. High-density electromyography (HDEMG) has been used to investigate changes in back muscle activity in people with cLBP. Previous studies have utilised static or mono-planar tasks or focussed on small areas of the erector spinae (ES). This study uses innovative HDEMG and kinematic analysis to investigate the effect of cLBP on muscle activity and movement during a multi-planar lifting task.

Methods

Sixteen people with cLBP (8 male, age: 26.9±10.8 years) and sixteen age and gender-matched controls (7 male, age: 31.7±14.0 years) completed the study. HDEMG signals from the ES were detected with four 64-channel semi-disposable 13x5 electrode grids (2 grids bilaterally) covering the lumbar and thoraco-lumbar ES. Kinematic surface markers were placed over the back, enabling 3D motion capture.

HDEMG and kinematic data were recorded continuously during a dynamic task involving the cyclical lifting of a 5kg box between 6 shelves for 10 cycles (~7 minutes). The shelves were arranged around the participant, at knee and sternal height, with one pair of shelves anterior and two pairs lateral. To the beat of a metronome, the participant moved the box between shelves, returning to a central shelf each time (10 movements).

HDEMG amplitude data were normalised to the first cycle for each movement to a shelf, and factorial ANOVA's used to compare subsequent cycles to the first.

Results

Kinematic analysis revealed no significant differences between groups in the movement pattern used to complete the lifting task ($P>0.05$ for all relevant outcomes). Despite similar movements, significant differences in muscle activity, were seen between groups. The cLBP group showed systematically higher amplitude, indicating higher levels of muscle activity, in 6/10 shelf movements ($P<0.05$), lower amplitude, implying lower muscle activity, in 1/10 ($P<0.05$) and no difference in the remaining 3/10 ($P>0.05$).

Conclusion

As the data were normalised and amplitude is a measure of muscle activity, these results indicate that for a majority of movements, the activity in the ES for the LBP group did not show as great a reduction over the task as that of the control group. These data therefore support an altered motor control strategy in participants with cLBP. While no differences were found in the movement strategy, likely due to the standardisation of the task, cLBP participants showed lower reductions in activity, indicating that already fatigued or dysfunctional muscles remained in use throughout the task.

Implications

This project used innovative technologies and a complex task with real-life applicability to improve understanding of the cLBP driven changes occurring within the ES. By understanding these changes in a task of daily life, we gain valuable information on muscle activity and motor control which is relevant to clinical practice to aid in the development of novel rehabilitation for cLBP.

Keywords

HDEMG, Muscle Activity, Low Back Pain

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