NEUROMUSCULAR RESPONSE OF TRUNK MUSCLES DURING MANUAL LIFTING TASKS AT HIGH FREQUENCY WITH LIGHT UNSTABLE LOADS

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Introduction

The revised NIOSH lifting equation is a widespread risk assessment tool that it is used in the decision-making process of designing a job that contains repeated lifting tasks [Waters, 1993]. A limitation of the equation is that it does not include unpredicted factors like unstable loads. Therefore, the aim of this study was to determine the effect of an unstable load and its interaction with the NIOSH equation multiplier factors on the trunk musculature during lifting tasks.

Methods

A split-plot experimental design with repeated measurements on experimental units was used in this study in order to investigate the main effects of four subject-normalized factors: **L**oad (liquid or solid, weight = 67 N), **V**ertical (knee or hip) and **H**orizontal distance (near or far) and **A**symmetry (0º or 45º, left turn) and their interactions, on the control of voluntary trunk movements during lifting tasks (4 lift cycles, 30 lifts/sec) for 7 males and 7 females participants. Therefore, each participant was considered as block and repeated measurements made on each block under factorial treatment structure.

Figure 1: Experimental set up showing a subject during the lifting task.

The response variable was the RMS of the EMG (Figure 1) of each of the 10 studied muscles, left and right: erector spinae, rectus abdominis, external and internal obliques and latissimus dorsi. The myoelectric signals were registered using the active sEMG sensors DE-2.3 (Delsys Inc., Boston MA) and digitized at a rate of 1 KHz using the Myomonitor IV (Delsys Inc., Boston, MA) portable EMG 16-ch system (16 bits, range ± 5 V). Once ECG artefacts removed [Hof, 2009], the EMG signal was filtered (4th - order Butterworth, 20 - 450 Hz) [DeLuca, 2010], demeaned and stored in ASCII files.

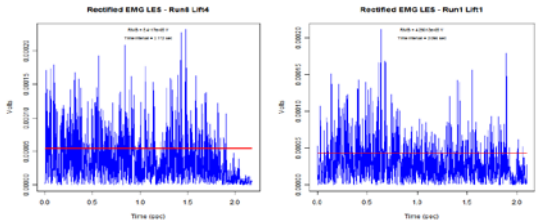
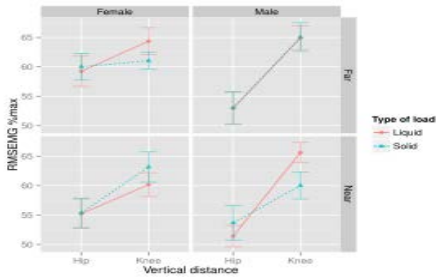


Figure 1: RMS of the EMG amplitude during a lifting trial of the left erector spinae of a subject (RMS_{LIQUID}= 5.41e-05 V, RMS_{SOLID}=4.29e-05 V).

Results

The results of the mixed-design ANOVA revealed that unstable load influence the muscle intervention (Figure 2).



Mean RMSEMG (%max) of the V:H:L interaction term at each level of gender factor for the left latissimus dorsi.

Discussion

Further investigation is needed to understand how unstable loads influence muscle intervention and consequently internal loads on tissues and anatomical structures.

References

Hof, AL, J Electromyogr. Kinesiol. 19: e554-e555, 2009.
Luca, CJD, *et al*, J Biomech, 43:1573-1579, 2010.
Waters, TR, *et al*, *Ergonomics, 36:* 749-776, 1993.