MOTION INDUCED INTERRUPTIONS INCREASE THORACOLUMBAR KINEMATICS

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INTRODUCTION

Working on a moving platform, such as a seagoing vessel, imposes an increased risk for low back injury [1]. Such a dynamic environment will force a person to make continuous postural adjustments in order to maintain stability while performing a manual materials handling task. In some circumstances, these adjustments may require foot repositioning to maintain the centre of mass location within the confines of the base of support. A motion induced interruption (MII) occurs when the external perturbations are large enough to cause a person to stumble or abandon a task [2]. The purpose of this study was to evaluate the differences in thoracolumbar kinematics between lifts successfully executed and those during which a MII occurred.

METHODS

A ship motion simulator was employed to produce a pitch motion while 19 volunteer participants performed lifting activities. The activities consisted of lifting a 15kg mass under four conditions: a) load starting from floor with a final horizontal displacement of 300mm (Close Floor); b) load starting from floor with a final horizontal displacement of 400mm (Far Floor); c) load starting 250mm above the floor with a final horizontal displacement of 300mm (Close High) and d) load starting 250mm above the floor with a final horizontal displacement of 400mm (Far High). In all conditions the net vertical displacement was 750mm. Lifts were repeated at 10s intervals for a period of approximately two minutes. The 15kg load was connected to a handle which could be easily gripped symmetrically with two hands. The origin and destination of the lift were clearly identified and controlled between subjects. The load was returned to the ground by an investigator in preparation for the next lift. Thoracolumbar motions were collected with a Lumbar Motion Monitor (LMM) and stored on a personal computer for analysis.

A handheld signal was used by one of the investigators to identify the start and finish of each lift as well as the MII incidence. This temporal marker was sampled by an A/D converter and stored on a computer for subsequent analysis. These events were validated during analysis by referring to data collected from a load cell built into the load-handle apparatus. During the analysis procedure each lift was classified into two categories, a successful lift during which no foot adjustments were required or a lift completed but the participant was required to adjust the position of the feet in order to maintain balance (i.e. a stumble).

RESULTS AND DISCUSSION

The maximum LMM velocities in the lateral, sagittal and twisting planes were compared across the four lifting tasks. A repeated measures ANOVA indicated that there were significant increases ($p<0.001$) in thoracolumbar velocities in all three planes of motion for the lifts during which stumbles occurred compared to those lifts executed without MII's (Figure 1). This directional change was consistent across all lifting activities. What was most interesting is that the largest relative increases occurred in the lateral bending and twisting planes. Increases in thoracolumbar velocities in these planes of motion have been related to increased risk for occupationally-related low back disorders [3].

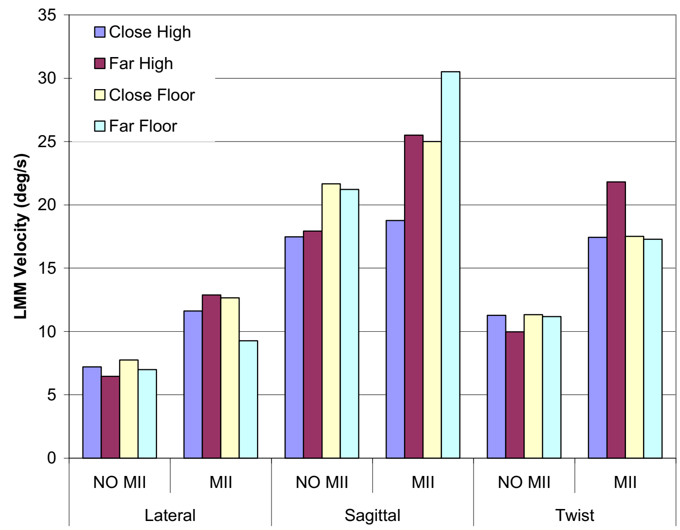

Figure 1: Three-dimensional LMM velocities across lift condition.

CONCLUSIONS

While humans can be quite adept in making dynamic compensatory adjustments to maintain balance, these strategies may not compliment a person's goal of reducing the risk of personal injury.

REFERENCES

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