THORACOLUMBAR KINEMATICS DURING LIFTING EXERTIONS IN MOVING ENVIRONMENTS

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INTRODUCTION

Seafaring occupations have been long recognized as a high risk occupation for injury and accidents and it is hypothesized that the external perturbations associated with vessel motions are responsible for the high incidence of low back exertions common to professional mariners [1]. Studies have shown that large thoracolumbar velocities during lifting activities, as measured by a Lumbar Motion Monitor (LMM), are related to an increased risk of low back overexertion injuries in several industrial occupations [2]. The purpose of this study was to examine the changes in thoracolumbar kinematics of persons performing a lifting activity while exposed to simulated ships motion compared to those collected under stable, laboratory conditions.

METHODS

Nineteen healthy male subjects volunteered to participate in this study. These participants were asked to perform repeated bi-manual symmetrical lifts (6 lifts.min^{-1}) while thoracolumbar kinematics were collected employing a lumbar motion monitor (LMM). 10kg and 15kg loads were considered in this study and lifted through a vertical displacement of 750mm. The articulation between the mass and the handle was made by either a solid metal column (i.e. stable load) or a series of chain links (i.e. unstable load). A ship motion simulator was employed to produce three different platform motions during which the participants lifted loads. The platform motions were described as pitch, roll and quartering seas. Thus a 3 floor motions by 4 loads design was considered in this experiment. The maximum angular velocity in the lateral bending (LB), sagittal (SG) and twisting (TW) planes were calculated from the collected displacement data and were compared across load and motion conditions using a repeated measures ANOVA.

RESULTS AND DISCUSSION

It can be generally stated that the motions of the simulator platform influenced the maximum LB, SG and TW thoracolumbar velocities relative to the baseline laboratory condition. What was most interesting was the direction of these changes. There was a significant increase in the maximum LB ($p<0.001$) and TW ($p<0.001$) velocities for the platform motion conditions relative to the laboratory condition. In both thoracolumbar directions it was the pitch motion that induced the greatest increases in velocity compared to the laboratory values. What was most surprising is that the maximum SG velocities decreased significantly ($p<0.001$) relative to the stable, laboratory condition for all motion conditions, with pitch demonstrating the greatest reduction. SG reduction is characteristic of trunk stabilizing strategies exhibited by low back pain sufferers performing trunk extension activities [3].

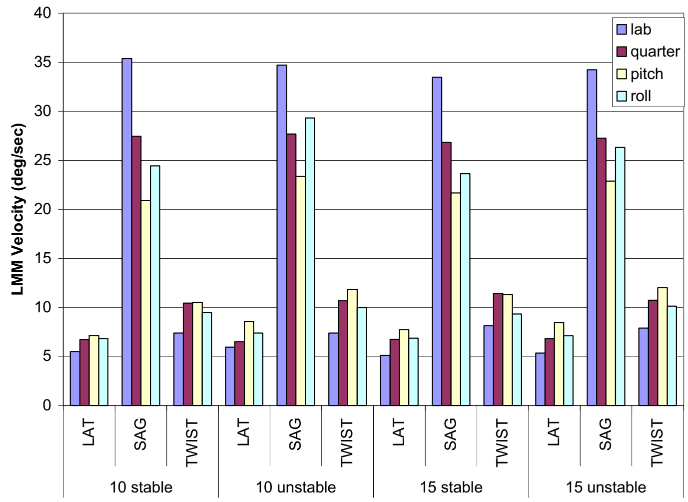

Figure 1: Maximum thoracolumbar velocities across load and motion conditions.

The type of load handled significantly affected the magnitude of the maximum TW velocities ($p=0.026$). In general, there were greater TW velocities when handling the unstable loads compared to the stable loads under the motion conditions.

CONCLUSIONS

Performing lifting tasks in motion environments, particularly with unstable loads will likely increase the risk of overexertion injury to the lower back due to the increases in maximum angular velocities in the lateral bending and twisting planes. Further studies examining if there are changes in lifting strategies while working in a motion environment are warranted given the unexpected decreases in sagittal plane motions occurring at the lower back during the motion conditions.

REFERENCES

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