LOADS ON THE LUMBAR SPINE DURING A WORK CAPACITY LIFTING TASK

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INTRODUCTION

Manual material handling tasks, such as lifting and lowering, are considered to be major risk factors in the development of low back pain (de Looze \textit{et al.} 1998). Research conducted in the United States by the Bureau of Labor Statistics (Occupational Safety and Health Administration 1993) indicated that four out of every five manual handling injuries occur in the lower back, with three of these injuries attributable to manual lifting tasks. Despite this statistic, a number of functional work capacity tests still employ manual lifting as a method of assessment for return to work condition (Innes & Straker 1999). Many of these tests have not been standardised or validated and generally fail to consider the injury implications of low back loading.

METHODS

Six subjects (3 male and 3 female) were required to lift five different loads, ranging from 2.5 kg to 22.5 kg. The subjects (mean age 37.6 yrs) were free of any low back problems at the time of lifting. Each lifting task was filmed using a single camera (Panasonic NV-MS5) perpendicular to the plane of motion. 2-Dimensional kinematic data was derived using video digitisation software (Peak Performance Technologies) and ground reaction forces using a force platform (Kistler Instruments). The kinematic data was used to calculate compressive loads on the L4/L5 joint in the spine using the 4D WATBAK modelling software (University of Waterloo, Canada). Surface electrode Electromyography (EMG) was used in association with the Amlab II program (Amlab International) to detect muscle activity in the left and right Erector Spinae (L2 and L4 joints) and the Rectus Abdominus. The root mean square of all raw EMG’s was calculated over consecutive periods of 200ms, using Microsoft excel, throughout the full range of motion of each lift.

RESULTS AND DISCUSSION

![Figure 1: Compressive forces (mean) at the L4/L5 joint in the lumbar spine for the male (clear) and female (shaded) subjects.](image)

In 1981 the National Institute for Occupational Health and Safety (NIOSH) published guidelines that indicated an upper limit of 3433N for the compression force (action limit) acting on the L4/L5 joint as a maximum working tolerance. Figure 1 shows the mean compressive forces for the male and female subjects in each lifting test. In this study 4 out of 6 of these subjects exceeded the NIOSH action limit in the 22.5 kg test. Additionally two of the subjects were also over this limit on the 12.5, 17.5 and 22.5 kg test. Bilateral EMGs from the Erector Spinae at both L2 and L4 generally increased as the mass of each lift was elevated (Figure 2). This elevation in muscle activity no doubt contributed to the increased compressive forces experienced during the heavier lifts. In comparison, activity in the Rectus Abdominis remained relatively constant across the five different lifts. Thus, although important for maintaining intra-abdominal pressure, the Rectus Abdominis did not contribute to the additional compressive loading on the lumbar spine as the mass of the load increased.

SUMMARY

Lifting loads of 22.5 kg or more in the manner of the work capacity assessment test produces spinal loads that exceed one or more of the previously reported tolerance limits and potentially predisposes individuals to injury.

REFERENCES


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