

# The Influence of Initial Horizontal Weight Placement on the Loads at the Lumbar Spine While Lifting

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**Study Design.** This was a biomechanical study of the effect of the initial horizontal distance between a person lifting and the load. Experimental data were analyzed using a dynamic rigid link model.

**Objective.** To determine the effect of the initial horizontal load placement on the moments acting on the lumbar spine and the lower extremity joints during lifting, and to determine the role of the lower extremities during lifting from the floor.

**Summary of Background Data.** Epidemiologic studies have implicated lifting as a cause of back pain, and over 80% of all worker's compensation back injuries are considered to be caused by manual material handling. Guidelines have been proposed to increase the safety of lifting, but they are primarily based on static biomechanical analyses, psychophysical data, and physiologic limitations.

**Methods.** Each of 12 male subjects lifted a weight box containing 0 to 300 N, in 100-N increments. Each subject performed 20 lifts—four weights at five horizontal distances (20, 30, 40, 50 and 60 cm). Motion was measured with an optoelectronic system, ground reaction forces were measured with a force plate, and moments were calculated using a rigid link model.

**Results.** The peak predicted L5-S1 moment increased as the weight and horizontal distance increased. The influence of horizontal distance on moment magnitude was nonlinear. As the distance changed from 20 to 40 cm, the distance-related rate of increase was approximately one-half of that occurring with a distance change from 40 to 60 cm. This can be explained by the need to reach out further, beyond 40 cm, which is accomplished by a deeper flexion of the knees and ankles and an anterior translation of the upper body and arms.

**Conclusion.** As the horizontal distance at the start of a lift increased, the peak moment acting on the lumbar spine also increased, but the increase was nonlinear. This is explained by a change in the technique of lifting when the distance is 40 cm or greater. [Key words: back injury, dynamic model, lifting, lifting posture, lumbar spine, weight placement] *Spine* 1995;20:1895-1898