Biomechanical Analysis of Occupational High Exertion Tasks

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Manual work is still very prevalent in many jobs today. Often extremely high levels of exertion are required, and the preponderance of epidemiological evidence indicates that these tasks cause and precipitate excessive numbers of low back and other musculoskeletal pain and suffering for thousands of workers, along with high medical and compensation costs. The focus of this presentation will be on occupational low back pain. The discussion begins with the fundamental biomechanical reality; that the lumbar spine is often subjected to extremely large compression forces when one stoops to pick up an object, even if the object is of moderate weight. Biomechanics research has disclosed that such compression forces will cause premature vertebral disc fractures in many people. Postural effects of twisting and moving have recently been shown to add to the risk of compression failure.

During the 90s measurement methods and biomechanical models became available to begin to understand the affects on the lumbar spine of complex motions. Recently some biomechanics research began to focus on another aspect of vertebral column function that makes it vulnerable to injury, particularly during fast motions with light loads. This vulnerability is due to the column’s reliance on well coordinated torso muscle contractions to control its inherent dynamic instability. Such instability could explain why low back pain is often associated with performance of tasks when: 1) an occasional and possibly poorly planned motion takes place, 2) a sudden or unexpected motion (such as a foot slipping) takes place, or 3) when torso muscle fatigue is present.

The result of this body of work is to propose that future prevention strategies will have to be much more sophisticated than is presently the case. There is a clear need for better dynamic biomechanical risk models. It also is proposed that work cell design strategies must take advantage of newer digital human modeling CAD technologies to assure that known biomechanical risk factors are mitigated early in the design process.