EFFECT OF ORIENTATION ON MEASURED FAILURE STRENGTHS OF THORACIC AND LUMBAR SPINE SEGMENTS

Sai Vikas Yalla[1], David Burnett[1], Naira H Campbell-Kyureghyan[1]

[1]University of Louisville

ABSTRACT

Current criteria (NIOSH) for evaluating the risk of low back injuries (3500N for failure) are based on studies that did not consider spinal segment orientation. The current study examines the effect of segment orientation on the measured failure strengths for lumbar and thoracic spine motion segments.

18 motion segments (two vertebral bodies and intervertebral disc) dissected from 8 fresh intact thoracolumbar spines (4 male, 4 female) were tested for compression failure at either the neutral Harrison angle (normal standing human body posture) or in-line axially (non-oriented testing) in a special loading fixture. Each segment was subjected to a static preload of 350N to simulate torso weight. A quasi-static axial compressive load was applied at a displacement controlled rate of 0.0012 mm/sec. The resultant failure force was determined by a drop in sustained force. In order to compare with prior studies, failure force, stress, and strain were tabulated.

Result show that orientating the lumbar specimens in the neutral position decreased their failure force and strain by 12% and 17% respectively. Conversely, oriented thoracic segments failed at 5% higher force and 27% higher strain. Normalized failure parameters such as stress were also analyzed and indicate the inadequacy of force as the only failure measurement. Results reveal a considerable difference in failure force with respect to orientation and the need to consider other failure criteria. Methodological differences of previous studies from our current research were examined.

Generally, lower failure forces were observed compared to prior studies. Differences in failure force with respect to orientation emphasize the significance of orientation and the need to reconsider the load limits in criteria for injury tolerances. The results may be used to develop better injury prediction methodologies and thereby reduce the incidence of spinal injuries.