Restraint and Speed Dependency in Hybrid III Thoracic Injury Prediction: A Comparison of Hybrid III and Cadaver Chest Deflection Response in Restrained Frontal Sled Tests

Jason Forman[1], Richard Kent[1]

[1]University of Virginia

ABSTRACT

Background and Objective: *The prediction of thoracic injury based on Hybrid III (H3) chest deflection in a frontal crash is dependent on the speed of the crash and the type of restraint employed. In contrast, the prediction of thoracic injury based on cadaver chest deflection is independent of the speed of the crash and the type of restraint employed. To investigate this limitation in H3 thoracic injury prediction, this study investigates the relationship between H3 and cadaver chest deflection under loading from various restraints at various test speeds in frontal crash tests.*

Methods: *Chest deflection results were examined for matched H3 and cadaver frontal sled tests performed at UVA using four different restraint and speed test configurations: A) force-limited 3-point belt plus airbag restraint, 48 km/h ΔV; B) standard (not force-limited) 3-point belt plus air bag restraint, 48 km/h ΔV; C) lap belt plus air bag restraint, 48 km/h ΔV; D) standard 3-point belt restraint, 29 km/h ΔV. For each cadaver test, R_d is defined as the ratio of maximum cadaver chest deflection to maximum H3 chest deflection under matched test conditions.*

Results: *The average (and standard deviation) R_d values for each test configuration were as follows: A) $R_d = 0.83 \pm 0.24$; B) $R_d = 0.83 \pm 0.21$; C) $R_d = 0.59 \pm 0.04$; D) $R_d = 0.83 \pm 0.01$.*

Discussion: *In these tests, the relationship between H3 and cadaver maximum chest deflection is dependent on the speed of the test and the type of restraint employed. This may result in the restraint-and-speed dependence of H3 chest-deflection-based thoracic injury prediction. It is shown that the H3-based thoracic injury risk function may be transformed, approximately, into the restraint-independent cadaver-chest-deflection-based injury risk function using the ratios described above.*