Biofidelity Evaluation of Anthropomorphic Test Devices (BioRIDII, RID3D, Hybrid III) in Low and Moderate Speed Rear Impacts

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ABSTRACT

The goal of this study is to evaluate the biofidelity of rear impact anthropomorphic test devices (ATDs), two rear impact ATDs (BioRIDII and RID3D) and a HybridIII 50th percentile male ATD, by comparing their responses with post mortem human subjects (PMHS) in realistic rear impact test conditions. Three repeat sled tests for each ATD and seven PMHS tests were conducted under identical low speed (V = 17 km/h) and moderate speed (V = 24 km/h) rear impact test conditions. An experimental seat system that is capable of simulating the dynamic characteristics of current seat backs was developed to simulate a realistic test environment for rear impact loading. The experimental seat contains a total of fourteen load cells (four on the seat pan, six on the seat back, and four on the head restraint) installed such that external loads from the ATDs can be measured to evaluate the external biofidelity (EB) of the dummies. Instrumentation for the PMHS was installed at locations based on the standard sensors for the ATDs (i.e., head, T1, T8, T12/L1, pelvis) so that a direct comparison between PMHS and ATDs could be made to evaluate internal biofidelity (IB). Biomechanical targets (i.e., corridors) for external and internal biofidelity were created based on the seven PMHS responses to both low and moderate speed rear impacts. In order to compare the ATDs quantitatively, the NHTSA Biofidelity Ranking System was utilized to assess the internal and external biofidelity of each ATD. In the low speed condition, preliminary results show that the BioRIDII (1.26 EB rank score/1.35 IB rank score) exhibited better external biofidelity than the RID3D (1.63 EB/1.38 IB) and Hybrid III (1.74 EB/2.19IB), while the BioRIDII and RID3D both produced a better internal biofidelity score than the Hybrid III. Similarly, in the moderate speed condition the BioRIDII (1.35 EB/1.32 IB) had the best external biofidelity score and the BioRIDII and RID3D (1.53 EB/1.27 IB) exhibited better internal biofidelity than the Hybrid III (2.08 EB/1.54 IB). Numerical techniques for creating the biomechanical targets from the PMHS data, such as normalization and removal of phase differences, will be used to finalize the NHTSA Biofidelity Ranking Score for this biofidelity evaluation of the rear impact ATDs in the future.