

Humerus and Forearm Bending Risk Functions for the 50th Percentile Male

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ABSTRACT

The increase in upper extremity injuries in automobile collisions, because of the widespread implantation of airbags, has led to a better understanding of humerus and forearm injury criteria. The next step is to develop risk functions for upper extremity injury that can be used in instrumented upper extremities. This paper presents risk functions for humerus and forearm injury for the 50th percentile male based on bending fracture moment data gathered from previous studies. First, the data were scaled depending on the orientation of the test or specific anthropometric considerations, such as pronation versus supination in the forearm. Second, the data were mass scaled to that of a 50th percentile male occupant. Third, given that some tests were performed at quasi-static rate, the peak moments were scaled to simulate dynamic strain rates observed in the cadaver upper extremity tests subjected to deploying airbags. A Weibull survival analysis model was then used to develop the risk functions. It was determined that a 25% risk corresponds to 214 Nm bending moment for the humerus and a 82 Nm bending moment for the forearm, a 50% risk corresponds to 257 Nm bending moment for the humerus and a 100 Nm bending moment for the forearm, a 75% risk corresponds to 296 Nm bending moment for the humerus and a 117 Nm bending moment for the forearm. It is believed the risk functions can be used with an instrumented upper extremity during vehicle testing.