

Oblique occupant injury research in the aircraft environment

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Aircraft occupant safety standards during an emergency landing condition are defined by the United States Federal Aviation Administration (FAA) in Title 14 of the Code of Federal Regulations (CFR) Parts 25.562 and Parts 23,27, and 29. The focus of these requirements are the protection of the occupant in forward and aft facing seats during impacts in the vertical and forward directions. With the incorporation of obliquely-mounted seating configurations in new aircraft designs, appropriate safety standards are needed to ensure that these seats have an equivalent safety level as forward-facing seats. In previous research related to far-side vehicle crashes, the response of the human body to a 60-degree side vector was different from pure frontal or pure lateral loading. Research in the automotive field is evolving to develop metrics to characterize oblique impacts. The mechanism and likelihood of such injuries in oblique seats on airplanes are not well understood. This is because epidemiology-based field injury data do not exist for aircraft crashes. Because of difficulties and sampling issues in establishing world-wide databases in aviation environments, injury research often relies on laboratory testing with Post Mortem Human Surrogates (PMHS) and Anthropomorphic Test Devices (ATD). The research design includes matched-pair testing of PMHS and ATD using an acceleration sled. Code of Federal Regulations Part 25.562 Emergency Landing condition of the FAA will be used as input. Surrogates will be positioned on a custom seat mounted to the top of the acceleration sled such that the impact vector is aligned between the sagittal and coronal planes. Instrumentation includes accelerometers and angular rate sensors at the head, spine, pelvis and lower limb. Three-dimensional kinematics will be derived from retroreflective markers attached to salient anatomical landmarks. Data gathered and filtered according to the Society of Automotive Engineers specifications (SAE J211) will be analyzed to compare the responses from the PMHS and ATD. Initial evaluations will include peak forces and times of attainments of peak forces, head linear and angular accelerations, spinal kinematics and derived variables such as normalized deflections. Pre- and posttest x-ray and CT images will be compared to identify injuries. These data can be used to determine the appropriate ATD and develop injury criteria for oblique loading in the aircraft environment.