Injury Risk Assessment and Criteria Development

Using the Biodynamic Data Resource to Derive Injury Risk Curves Under Different Impact Load Vectors

Biomechanical experiments replicating field injuries are necessary to determine injury mechanisms and tolerances in terms of variables like acceleration. Studies of non-contact impact acceleration tolerance using human volunteers and nonhuman primates (NHP) were conducted from 1973 to 1989 at the Naval Biodynamics Research Laboratory. The Biodynamic Data Resource (BDR), a database from these tests, is kept by the U.S. Army Aeromedical Research Laboratory (USAARL). Researchers at the Medical College of Wisconsin (Milwaukee, WI) and USAARL collaborated to analyze the NHP data in the BDR and develop Injury Risk Curves (IRC) for non-contact impact acceleration.

Data from tests in the +Gz loading direction were included; this vector is associated with impacts such as those from underbody blasts. Over 400 tests with NHPs were conducted, but only those with accelerations at potentially injurious levels (38 g or greater) were included in this analysis (n = 27) (*Abraczinskas et al., 2018*). Medical records were analyzed to determine whether cardiovascular, thoracic, or cervical injuries occurred, and IRCs were developed with acceleration as the response variable.

Of the 27 included tests, 11 were non-injurious and 16 were injurious. The primary injuries were thoracic injuries, followed by cardiovascular and cervical injuries. Mean acceleration magnitudes of 42, 55, and 87 g were associated with 25, 50, and 95 percent probabilities of injury, respectively. The quality indexes were in the good to fair category at these risk levels. With the use of appropriate scaling techniques, these acceleration thresholds could be comparable to human tolerances for +Gz loading, which is important for designing protection from underbody blasts while in a vehicle.

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REFERENCES:

Abraczinskas, A., Christine Beltran, Ardyn Olszko, Jamie Baisden, Narayan Yoganandan, Frank Pintar, Andrea Dargie, Kimberly Vasquez, and Valeta Chancey. (2018). Injuries and Injury Risk Curves from Historical Non-Human Primate Whole-Body, +Gz Acceleration Tests. 18-108.