REDUCTION OF BLAST-INDUCED CONCUSSIVE INJURY POTENTIAL AND CORRELATION WITH PREDICTED BLAST IMPULSE

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ABSTRACT

The blast wave that is generated from the detonation of an explosive device can induce significant accelerative loading to the head of an individual, when the wave collides with the victim. As a result, there exists a potential for blast-induced concussive head acceleration injury. To examine this potential, anthropomorphic mannequins in a standing position, instrumented with accelerometers in the heads, were exposed to the blasts from detonating charges of C4 explosive. The charge sizes, ranging from 5.1 kg to 17.5 kg of C4 placed at a standoff distances between 2 and 5 m, were chosen so as to be representative of an EOD or IEDD scenario. The signals measured in the heads of the mannequins were examined using the Head Injury Criterion (HIC), and the Prasad-Mertz injury probability curves. This analysis allows for a probabilistic breakdown of concussive injury potential by AIS (Abbreviated Injury Scale) level. A spectral analysis of the measured signals confirmed the validity of using the HIC for blast-induced head acceleration. The injury analysis indicates that blast induced head acceleration can reach injurious and fatal levels when an individual faces a detonating explosive device while unprotected. Properly designed EOD personal protective equipment (EOD-8 and EOD-7B by Med-Eng Systems), which includes a full-faced helmet effectively integrated with a body protection system, was demonstrated to provide significant protection, both by reducing the levels of acceleration experienced and by dramatically reducing the predicted injury potential.

An analysis was also performed, which extrapolates the results obtained in the current experimental studies to other test conditions, by relating the HIC to the impulse of the blast event. This has allowed for the creation of a working chart that predicts concussive injury potential for various charge sizes and standoff distances, for both the protected and unprotected individual.