



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Mechanics of Head Injury

Head Surrogates for Assessing Blast Overpressure Exposures

Blast exposures during training are controlled and maintained within safety standards, but there is concern over the effects of repeated exposure, even to low level overpressure. Quantifying the overpressure of a blast event in air is relatively straight forward, the challenge is to determine the amount of energy that penetrates into the brain. To this end, researchers at the U.S. Naval Research Laboratory (NRL; Washington, DC) and the Walter Reed Army Institute of Research (WRAIR; Silver Spring, MD) updated the NRL GelMan head into a modular format and constructed several gel-based brain surrogates with internal pressure sensors and accelerometers for mounting within the surrogate head.

A series of experiments examined overpressure penetration into the brain with and without a helmet in breacher training environments. Preliminary results from these studies indicate that at the highest overpressure exposure tested (approximately 100 kPa), the under-helmet pressure was approximately 40 percent of that measured at the eye. At low to moderate overpressures, the presence of a helmet resulted in an approximately 30 to 40 percent higher brain pressure than having no helmet. At the highest overpressure tested, pressure in the brain was approximately 70 percent higher in the helmet scenario than in the no-helmet scenario.

The improved NRL GelMan surrogates will enable greater understanding of the relationship between external overpressure and that experienced by the brain. This knowledge may be used to evaluate training practices (e.g., change breaching stand-off distances) and develop better protective equipment.

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