RESPONSE OF THE BIPED HEAD PHYSICAL MODEL TO LOW LEVEL SHOCKWAVES

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Key words : mTBI – Head - Surrogate - IED - Shocktube

The BIPED headform was specifically developed by DRDC to assess the reduction in the risk of injury to the human brain (Blast Induced TBI) offered by combat helmets against low level shockwaves (Maximum of 200 kPa in peak incident overpressure) . These low level shockwaves are encountered frequently in theatre in part to the prevalence of improvised explosive devices and have the potential to cause serious long term effects on health. A study to improve the understanding of the load transfer mechanism from a propagating shockwave to the brain simulant in the headform was performed using a 400 x 400 mm square shocktube. The BIPED was mounted on a crash dummy neck and was exposed to two load levels with peak incident overpressures of 90 and 160 kPa and duration of 10-15 milliseconds respectively. The response of the bare headform was compared to the response of the headform with an open-face and full-face combat helmet. Head accelerations, pressures in the brain simulant as well as strain on the skull were measured. Three phases in brain pressure responses could be distinguished. The use of a helmet appears to decrease intracranial pressures in the first phase of the response while increasing it in the later phase. Finite Element (FE) simulations were performed to study the effect of the model skull stiffness and its modal response, and the effect of the neck mount vs unconstrained headform configuration. The FE study revealed that the increase of the third phase of intra-cranial pressure fluctuations is most likely due to rigid body motion of the skull exciting the brain simulant, which floats in water in the skull cavity, in its modal resonance frequency. The study resulted in a better understanding of the shockwave – head interaction and informed on the potential protection performance of combat helmets. It also showed that modal resonance frequencies are crucial in the load transfer to the brain and should be included in the biofidelity requirement for an head simulant.