Comparative Study of the Behavior of Different Tissue Surrogate Materials under Blast Loading

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Abstract

Current efforts to improve personal protective equipment (PPE) used by soldiers, first responders, and individuals participating in collision sports has resulted in an increased interest in the development of biofidelic and reasonably priced surrogates of different parts of the human body which can be conveniently used in a laboratory setting to test the effectiveness of new products and ideas. Furthermore, having better surrogates of different body parts can be useful in studies related to injuries sustained during accidents such as a car crash or a fall. In the events of interest the loading is applied in a very short period of time and is the result of an explosive blast or an impact (with or without penetration). The soft tissues involved depend on the scenario being considered and range from muscle tissue to the grey and white matters in the brain. Different materials have been proposed as possible surrogates for muscle tissue and for brain tissue. Understanding the mechanical response of those materials under impulsive loading from a blast or impact is an important aspect that is still being explored, particularly in the case of brain tissue surrogate materials in the context of research aimed at understanding the root causes of mild traumatic brain injury (TBI).

The purpose of this paper is to compare the mechanical response of different tissue surrogate materials under blast loading in a controlled laboratory setting. The comparison is performed using an experimental setup in which rectangular sections of the tissue surrogate materials considered are placed between two rigid plates. The test specimens are then exposed to a blast from a small scale compressed gas blast generator. High speed video and acceleration measurements are recorded and used to compare the dynamic response of the different tissue surrogates under similar loading conditions. The usefulness of the proposed experiment and the results obtained to help identify potential soft tissue surrogate materials that can be used to make surrogates of different parts of the human body is addressed.