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PROCEEDINGS

Hydrogels with Brain Tissue-Like Mechanical Properties in Complex Environments

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ABSTRACT

In surgical training applications and experimental research, brain tissues immersed in cerebrospinal fluid often involve very complex deformation and strain rate effects, which affects their reliability and stability. Thus, it is indispensable to develop a high-fidelity human brain tissue simulant material as a physical surrogate model to understand their mechanical behavior, such as traumatic brain injury (TBI). However, the reported simulant materials have not yet been able to compare and satisfy the above two mechanical properties. Here, we developed a novel composite hydrogel with brain tissue-like mechanical properties and investigated their mechanical behavior in a solution environment. The results demonstrate that this composite hydrogel shows some common features with fresh porcine brain tissue, such as nonlinear mechanical behavior and a good similarity under various external environments (artificial cerebrospinal fluid, saline solution, deionized water, and air environments) and strain rates (0.001s-1,900s-1,1700s-1). Furthermore, using a life-sized brain tissue mold, we successfully constructed a 3D brain-like tissue model based on this composite hydrogel, which validates the feasibility of surgical training on this model. Since the properties of human brain tissue are similar to those of porcine brain tissue, our work will have important reference value for the realization of surgical training and related research in biomedical engineering.

KEYWORDS

Porcine brain tissue; hydrogel; mechanical properties; solution environment; strain rate

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