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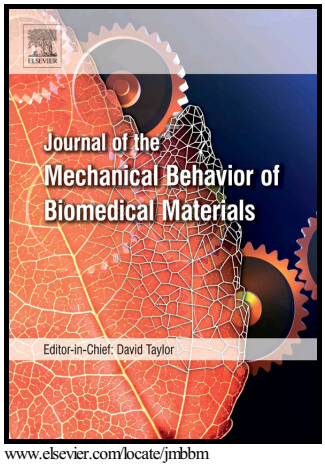

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A study of the damage behaviour of porcine intervertebral discs in a bioreactor environment

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Abstract

The intervertebral discs are cartilaginous, articulating structures that lie between vertebral bodies, allowing flexibility, transmission, modification, and also distribution of the forces to the spinal column. Disc degeneration is characterised by progressive loss of disc height and exaggerated radial bulging. Therefore, the spine becomes shorter, stiffer, and less mobile. In the last several decades, there is a strong need for a tissue engineering strategy that alleviates pain and restores spine function by directly addressing the underlying biological causes of disc degeneration. Numerous studies that are currently showing potential have been conducted on developing regenerative and reparative strategies for treating this condition. In this study, to numerically describe the anisotropic mechanical damage behaviour of discs, the pseudo-elastic damage model was applied. To experimentally picture the biomechanical response of discs and to study the damage mechanisms as well as the spinal disc herniation, a special bioreactor was evolved. The specimens were obtained from pigs aged six months. A total of eight functional spine units were taken from porcine lumbar spines (L1-L2). Firstly, the experiments were performed by using long-term cyclic uniaxial compression tests. Secondly, the mean value of experimental results with consideration of the different shapes and sizes of the samples was calculated. Afterwards, the experimental results were compared with outcomes of numerical simulations.

Keywords: porcine, intervertebral disc, damage, degeneration, bioreactor

1. Introduction

Lower back pain is a common clinical complaint whose symptoms arise from biomechanical sources. Degeneration of the intervertebral discs (IVDs) is strongly implicated as a cause of low back pain, see

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