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Title:

Mathematical modelling of articular cartilage deformation under impact loading: Application to drop impact testing

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Articular cartilage is a soft hydrated tissue covering the end of each bone at the joints. Cartilage has no known function other than maintaining mechanical competence of joints, allowing bones to move against one another without friction. But there is no need to underline its significance to health of a human body, since almost all the load transmitted by a human joint goes through the articular cartilage, and it prevents biomechanical damage caused by severe loading including impact loading. It is believed that severe articular impact can initiate post-traumatic arthritis. An impact loading of the joint constitutes the action of extremely high non-physiological loads applied very rapidly (for instance, due to a car accident, sports injury, or a fall from a height).

In recent years, a number of experimental studies have been conducted to investigate the mechanical behaviour and damage mechanisms of articular cartilage under impact loading (Verteramo and Seedhom, 2007; Burgin and Aspden, 2008). Some experimentally observed results have been explained using a non-linear viscoelastic impact model (Edelsten et al., 2010). At the same time, there is the need of a simple mathematical model, which allows comparing experimental results obtained in drop impact testing with impact loads of different weights and incident velocities.

A variety of mathematical models were suggested to describe the stress-strain response of articular cartilage that represents a multiphasic, structurally complex material possessing viscoelastic properties. The biphasic theory of Mow et al. (1980), which models the tissue as a mixture of a solid phase and a fluid phase, has demonstrated very good agreement with experimental results in the creep and stress relaxation tests (Soltz and Ateshian, 1998). The objective of this study was to investigate theoretically whether the main features of articular impact could be predicted using a linear viscoelastic theory or the linear biphasic theory.