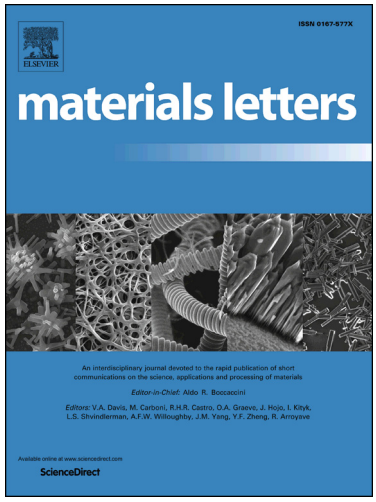

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Modulating the Poisson's Ratio of Articular Cartilage via Collagen Fibril Alignment

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Abstract

Articular cartilage possesses unique structure and composition giving rise to unusual mechanical behavior. Typically, it is a structurally graded material that displays variation in mechanical properties along the depth. In this communication, the geometrical probability approach has been used for predicting the in-plane Poisson's ratio in the surface and middle zones of articular cartilage. The presented model has formulated a relationship between the Poisson's ratio and collagen fibril alignment. A comparison has been made between the theoretical and experimental findings of Poisson's ratio in the surface and middle zones of human patella cartilage, as obtained from the literature.

Keywords: Biomaterials, Structural, Collagen, Poisson's Ratio

1. Introduction

Articular cartilage is a remarkable connective tissue of diarthrodial joints responsible for tolerating the intensive and repetitive physical stresses with low friction. It mainly consists of chondrocyte cells in an extracellular matrix (ECM), which is further made up of macromolecules including collagens, proteoglycans, glycoproteins and non-collageneous proteins [1,2]. The mechanical behavior of articular cartilage is driven by the microstructure and composition of ECM. The collagen fibrils present in articular cartilage are distributed inhomogeneously and their alignment varies along the depth of the tissue [3–6]. With the aid of atomic force microscopy (AFM) and other

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