INTRODUCTION. The present study investigates the load-structure relationship from the articular surface to the osteochondral junction in intact and fibrillated cartilage, using methods recently developed by the authors to study the micro-anatomy of cartilage in its loaded state.1

METHODS. Two groups of mature bovine patellae were identified at the time of harvest; those with intact cartilage (n = 10) and those with cartilage exhibiting mild to severe fibrillation (n = 9). Cartilage-on-bone samples were statically compressed (7MPa) to near-equilibrium using an 8-mm diameter polished indenter, and then formalin-fixed in this deformed state. Following mild decalcification full-depth cartilage-bone sections, incorporating the indentation profile and beyond, were studied in their fully hydrated state using differential interference contrast microscopy.

RESULTS. The lines of chondrocyte continuity1, which provide an 'imprint' of the overall arrangement of fibrils throughout the various zones, showed that the 'chevron' pattern observed in intact cartilage in compression contrasted sharply with the outward radiating pattern seen w.r.t the upper disrupted regions of the fibrillated cartilage (Fig. 1).

DISCUSSION. The differing patterns of deformation are best understood by showing how structural alteration influences the nature of the stress field. We argue that the chevron pattern in the intact tissue relates primarily to the maintaining of an internal hydrostatic pressure with little or no distortional energy (Fig. 4A). Conversely, in the fibrillated tissue the pattern of deformation is consistent with there being a net difference between the axial and tangential stresses. The distortional energy associated with this difference would, in turn, relate to the material constants (Fig. 4B).

CONCLUSION. The differences that exist between intact and fibrillated cartilage can be studied using differential interference contrast optical microscopy revealing clear distinctions in: 1). micro-structural response to compression, 2). the fiber-matrix integrity and 3). multiplicity of tidemarks and density of the calcified cartilage zone.

REFERENCES.

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