Investigating the Loading Behaviour of Intact and Meniscectomy Knee Joints and the Impact on Surgical Decisions

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Abstract

Knee joints are often subject to high loads, which can lead to injury, malalignment, and the progression of osteoarthritis in patients. To better understand the behavior, and the effect of meniscal damage and different meniscectomy repair approaches, a 3D structural mechanics model of a patient specific knee was developed in COMSOL Multiphysics®. The model made use of the Structural Mechanics Module, and Nonlinear Structural Materials Module to define contact between the various bodies and define the constitutive relations for the soft-tissue bodies and ligaments.
The model developed was then used to investigate the loading response of an intact, and two different meniscectomy repair surgeries for a medial meniscus defect, under the weight of the patient, and motion of the knee. Contact loads, stresses and the deformation of the cartilage and menisci were assessed and compared. A method of evaluating, and ranking the different meniscectomy repair approaches is discussed, with the aim of helping surgeons to better evaluate surgical strategies, and or implants, for a specific menisci defects and locations.

Figures used in the abstract

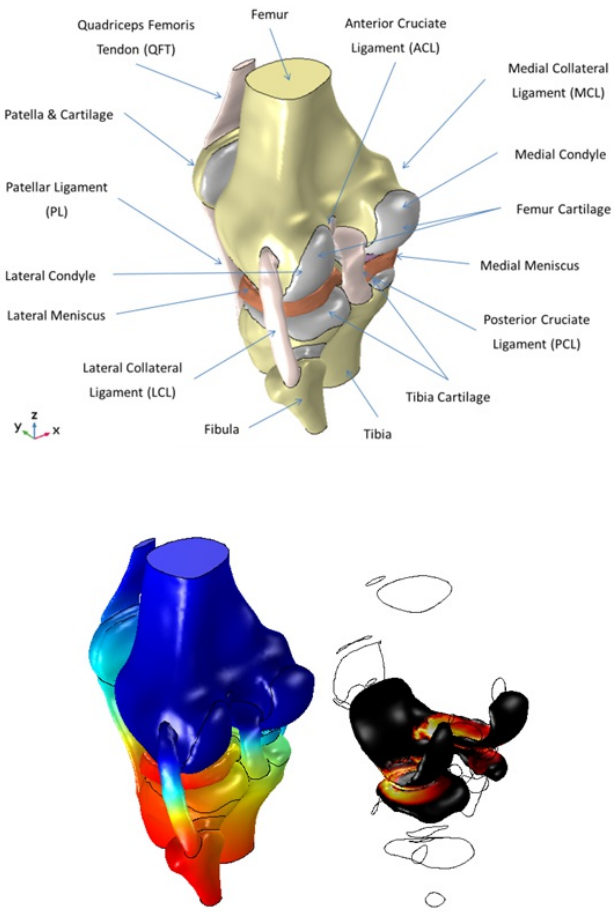

Figure 1: Finite element model features, intact knee displacement and contact pressure on femur and tibia cartilage.