Ultrasound experimental model for knee joint intra-articular movements

Ivan Mirchev Ivanov[1,2], Sergey Nikolov Ranchev[2]

[1]National Sports Academy "Vassil Levski", Bulgaria
[2]Institute of Mechanics, Bulgarian Academy of Sciences, Bulgaria
iivanov@imbm.bas.bg
serg_ran@abv.bg

Over 65% of the problems that occur in the human musculoskeletal system are of joint origin, and in some specific categories of work, including sports, it is significantly higher. The purpose of the present study was to develop an ultrasound experimental model for studying of the intra-articular femur-tibia displacements depending on the different vertical extra loads – 2, 5, 10, 15, 17 and 20 kg, applied on 17 healthy participants (7 men, 10 women).

The changes in millimeters of the distances between the femur and tibia were measured with ultrasound portable device at lower limbs straight pose near the iliotibial knee band. With increasing extraloads a decrease in femur-tibia distance was obtained. Quantitative data will help to create a mathematical model for the mechanical effects during deformation of the knee joint capsule, as well as to prepare quantitative method with software program for automatic calculation of femur-tibia kinematics from ultrasound images.

Such results are measured for the first time (in our opinion) and will be the basis for: (i) determination of the change of the contact area between the femur and the tibia under different axial loads; (ii) creation of a analytical model for evaluation of the deformation of the cartilage tissue from the contact area between the femur and the tibia under used axial loads; (iii) modeling the interaction between cartilage deformation and interstitial fluid flow from the cartilage into the joint cavity under loading.