

-THE ABSTRACT OF PH.D. THESIS-

**MODEL STUDIES OF THE STABILITY OF THE PATELLOFEMORAL JOINT  
DEPENDING ON ANTROPOMETRIC PARAMETERS**

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In this thesis the research to develop a methodology to study the effect of anthropometric parameters on patellar stability and to analyze their effects on the stability of the patellofemoral joint was performed.

A comprehensive review of literature has been made on the anatomy and biomechanics of the patellofemoral joint. In the clinical part of the theoretical considerations, the focus was put on anthropometric diagnosis of the patellofemoral joint stability. Next, the current state of art on the knee joint modelling and experimental methods for dynamic studies of the knee were described.

Afterwards, the analysis of the influence of anthropometric parameters on the patellar stability was performed. In Mimics Innovation Suite Software a special library was created to help determine anthropometrical landmarks. By defining appropriate mathematical formulas, the process of calculating anthropometrical indices for magnetic resonance imaging was automated. The method was used to determine the values of the anthropometrical indices for the study and control groups. Then in STATISTICA Software the analysis was performed to determine the parameters which differentiate the groups.

For the study of the dynamics of the patellofemoral joint, a 3D dynamic model of the knee joint was developed. The geometry of the model was created based on a CT scan of a 25-year-old man. In MADYMO Software a numerical model to analyze the dynamics of the joint was developed. The model was then verified by comparing the spatial relation of the patella and the femur with the results of a USG examination. The comparison showed good convergence (less than 10% difference).

At the next stage, the analysis of the dynamics for modified variants of the model was performed. New variants of the model were created by modifying the anthropometrical parameters like: patella height, trochlear depth, lateral position of the patella, tibial tuberosity lateralisation. The results are graphically presented in three-dimensional graphs. The mathematical relations of the lateral displacement of the patella and the contact force in the joint with the height of the patella and the position of the tibia tuberosity were determined. The results reveal the crucial impact of the patella height and a less significant impact of tibial tuberosity lateralisation and lateral position of the patella on the lateral patella dislocation.

Responding to the needs of the medical community, the methodology to estimate the patellofemoral contact forces and the patella lateralization was developed in a non-invasive way, basing only on medical imaging. Experimental evaluation of the forces between joint surfaces is impossible with other non-invasive techniques. The developed methodology of numerical simulations of the knee joint can be a useful tool in the complex process of preoperative planning.