

COMPLEX RHEOLOGY OF KNEE JOINT IN VIVO – EFFECT OF PATOLOGICAL CHANGES

¹Petr Kubovy, ²Michal Riha, ¹Karel Jelen, ¹Katerina Nikodymova, ¹Frantisek Lopot, ¹Tomas Holub, ¹Lucie Mensikova and ¹Stanislav Otahal

¹Biomechanics of Extreme Loading Lab, Dept. of Anatomy and Biomechanics, Faculty of Physical Culture and Sport, Charles University, Jose Martiho 31, 162 52 Prague 6, Czech Republic, web: <http://biomech.ftvs.cuni.cz>,

²Central Military Hospital Prague, U Vojenske nemocnice 1200, Prague 6, 169 02, Czech Republic, web: www.uvn.cz

INTRODUCTION

Couple of years we are trying to develop specific method of the measuring of the changes in the rheological properties of the knee joints. We use special apparatus for metering of the dependence between the torque and flexion angle during the passive bending of the knee. We try to evaluate and objectify rheological state of the joint and its progress from the acquired hysteresis curves. We numerate different kinds of the appraising parameters for comparing of the curves. Our effort head towards creation of the biomechanical models and help to create and objectify the medical diagnosis. This is rather simply, absolutely non-invasive method in vivo with zero stress on the organism. The knee joint is very intricate mechanism to exact separating the influences of the individual components to resulting mechanical properties. Therefore we measure the joints in various physiological and pathological statements and monitor the changes of the hysteresis curves. We are focusing in this cause on pathology of the patellar-femur articulation – the Wiberg's dysplasia. A unit of floorball goalkeepers with 13 members was very good useful like a check group (more than common dynamic movement on the knees).

METHODS

The resistance torque in relation to the knee flexion angle is measured by the special apparatus of an original construction. The movement of the leg is completely passive. The controlled quantities are the flexural interval of the knee (10°-90°) and the angular velocity of the shank "rotation". In order to facilitate the patient's relaxation we chose the lemniscate distribution of the angular velocity. The velocity rate (maximum 0,15 rad.s⁻¹) is limited from top by the capability of the sarcomere to relax and from below by the capability of the patients to keep concentrated. The whole movement is realized in the horizontal plane (patient lies on the side) in order to eliminate the gravitation effect on the torque. The shapes of the curves and their changes can be evaluated by various objectification parameters depending on the character. We were lucky, because the hysteresis curves of our probands account almost the same changes in its shape against "standard". Abnormal increase of the torque appeared only in a part of sample interval. Therefore we used three appraising parameters for quantification and comparing the curves: the angle interval with saltus change of the torque, position of its centre and mean quantity of the dissipation energy in the given interval (the space between the curves) (Figure 1). The Wiberg's dysplasia we assessed from a specific X-ray pictures (90° of flexion in the joint and parallel with os tibia axis). We evaluated angle of axis of contact surfaces angles (Figure 2) and mediary-lateral distance of vertexes. Subjective feelings and relate anamnesis we probed from special questionnaire. All of subjects were examined by doctor-specialist. Frontal and lateral x-ray pictures were snapped

for the rest pathologies control. Computing of the parameters and the statistical processing was performed in OriginPro software, x-ray pictures was gauged in the AutoCAD.

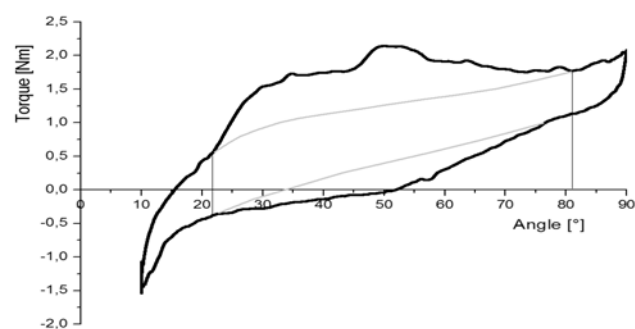


Figure 1: The graph of dependency between torque and flexion angle in a pathological (dysplasia) knee joint with the intervals of interest. The grey lines are hypothetical curves of healthy knee (for clearness only).

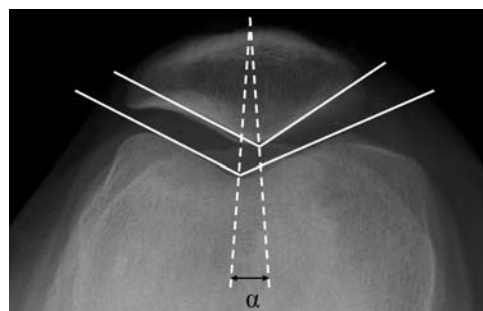


Figure 2: The measurement of dysplasia (schematic only).

RESULTS AND DISCUSSION

There were measured and snapped 13 floorball goalkeepers (5 female, 7 male, average age 23.6). 12 from them was positive finding of pathology with our apparatus, 9 with the same character of the curves. There was certified the dysplasia "major than it is norm" in 6 cases. 10 from probands were without subjective complaints with the knees.

CONCLUSIONS

Our experiment wasn't able to prove a direct correlation between the characters of measured hysteretic curves and dysplasia for very simplified methods of evaluation articulated knee shapes (will be necessary MRI, 3D reconstruction, ANOVA, more probands...), but it was implied lots of for future. It was proved sensitivity of our method to expose pathologies in them incipencies.

ACKNOWLEDGEMENTS

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