Relation between preoperatively determined knee varus angles and dynamic knee adduction moments

J. Funken1, K. Heinrich1, R. Müller1, R. Schmidt-Wiethoff2, W. Potthast1;
1Institute of Biomechanics and Orthopaedics, German Sport University Cologne, Cologne, GERMANY, 2ARCUS Clinics, Pforzheim, GERMANY.

The knee adduction moment (AM) is the surrogate indicator for the knee load distribution. Therefore the reduction of the knee AM in locomotive situations is the actual superior aim of high tibial osteotomies (HTO). For the last decades best practice of surgery planning was the realignment of the mechanical axis through the Fujisawa point in static erect standing. It is unknown, how the realignment of the mechanical axis in standing represents the reduction of the AM in dynamic loading situations (Amis, 2012). Further studies indicate that after executing HTO the knee AM re-increases in a two years follow-up. This suggests that HTO surgery planning based on static x-rays might be not comprehensive. The underlying assumption is that the static knee varus alignment is directly related to the dynamic load distribution. This would imply that a high correlation between the static varus angle and the dynamic AM exists. The purpose of this study was to relate preoperatively determined knee varus angles to dynamic knee AM.

In preparation for HTO patients (n = 10, mass = 82.4 ± 8.6 kg, height = 1.80 ± 0.05 m) were asked to walk in a laboratory environment with a speed of 1.7 m/s. Kinematic data were collected by a 3D motion capture system (Vicon Nexus, 100 Hz). Kinetic data were collected by two forceplates (Kistler, 1000 Hz). Peak joint moments were analyzed in all three movement planes using an inverse dynamic multibody model (Alaska, Dynamicus). Moments were normalized to body weight and height. The mechanical axis of the leg was calculated by x-ray and correlated with the AM of the knee joint.

Mean maximal AM was found to be 0.31 ± 0.10 Nm/kg/m. Mean varus angle was found to be 8.25 ± 2.08°. The coefficient of determination between AM and the x-ray angle was 0.44 (p<0.05).

HTO is proposed to enable patients to resume an active lifestyle. The results of this study show that 56% of the AM in a dynamic condition cannot be explained with the varus angle calculated by x-ray in a static situation. In more complex movements of daily living the AM is likely to be even less related to the x-ray angle. Inadequate realignments can be the reason for the retrogression after two years. Dynamic gait analysis and model-based preoperative calculations could help to analyze the patient’s movement profile and make HTO planning more individual, differentiated and loading specific.