

Berichte aus der Medizin

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The Compromise Pivot Axis of the Knee Joint

Studies of the Kinematics of the Human Knee Joint
in Regard to their Approximation in Prosthetics

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Orthopaedic practitioners need to know the position of the axes of supportive//braces for knee joints. Also it is important for designers of implantable alloarthroplastic knee joints and physicians to know whether resection of natural parts of the knee joint and their replacement with endoprotheses would change the statics and kinematics of the entire lower extremity resulting in long-term damages to joints or secondary damages to the bone structure itself.

The study was originally written as a thesis in 1975 at the Technische Universität Berlin [Berlin University of Technology]. However it is not widely known in the Anglo-Saxon room and therefore it was translated into English. In 1977 after a board decision the Deutsche Gesellschaft für Orthopädie und Traumatologie (German Society for Orthopedics and Traumatology) presented the Konrad-Biesalski-Award for these studies to Dr.-Ing. Manfred Nietert in recognition of his scientific achievements. In the meantime the results of this work are often quoted and the "position of the compromise pivot axis of the knee joint according to Nietert" serves many manufacturers as a basis for alignment guides of artificial limbs of the lower extremities and knee-ankle-foot orthoses, and also for hinged side-steels or bilateral long-leg braces. The position of the axis within the femoral condyles is important information when designing endoprotheses to replace knee joints. This has also been determined in this study.

The kinematic characteristics during flexion of the natural knee joint were studied systematically using cineradiography and electronic data analysis on 40 live and 4 deceased test subjects.

Centroides were calculated for 88 knee joints, then assessed and compared to each other. Also anatomical characteristics, such as the curvature radii of the femoral and tibial condyles, the lengths as well as attachment points for ligaments, play a significant role.

Changes in the position of trajectories generated during movement of the femur on a plane that is connected to the tibia or vice versa are so small in relation to a certain area of the knee joint that it can be defined as a single-axis joint moving around a so-called "compromise pivot axis". This is emphasised by the fact that trajectories approximate pure circular arcs with increasing distance from the centre. This study confirms the position of the knee axis to the front at approx. 60% of the diameter of the knee, measured from the front in the flexion plane. The vertical distance above the knee joint space is approx. 20 mm.