

A Technique to Measure and Insure Proper Soft Tissue Balancing in Total Knee Replacements

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Purpose: To develop an instrument to measure and insure proper soft tissue balancing of the knee during total knee replacement (TKR) surgery.

Introduction: Two important goals of a TKR are to reduce pain and restore function. There are several factors that influence the function and long term performance of total knee replacements. One important factor is soft tissue balancing insured by correct placement of the TKR components at the time of surgery. The normal, non-diseased knee is considered properly balanced when the deflection between both the lateral and medial femoral condyles and the tibial plateau is equal during the full range of knee motion. If this balance is not maintained, abnormal knee kinematics and excessive forces on the TKR and the surrounding soft tissues can result in abnormal gait, pain, and premature failure of the TKR.

Methods: The soft tissue balance measuring system consists of two components. The first component, the joint space measuring device, independently measures the distance between the medial and lateral femoral condyles and the tibial plateau (Figure 1).

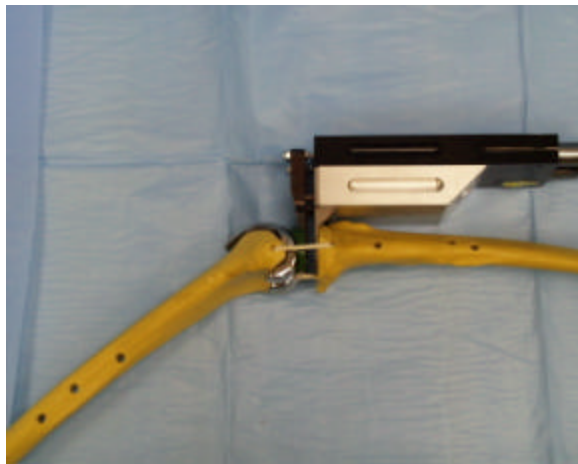


Figure 1 Joint Space Measuring Device

After a tibial cut is made, the joint space measuring device is inserted into the joint space. A flat, rigid metal plate sits stationary on the cut surface of the tibia. Two smooth polyethylene pieces with concave surfaces contact the femoral condyles and are connected to two spring loaded LVDT's that independently track the condyles displacement throughout the knee's range of motion. The second

component, the base, holds the femur rigid and has an arm that is connected to the tibia and rotates about the flexion/extension axis of the knee. The arm is connected to an RVDT to measure the flexion/extension angle. The distances between the femur and the tibia on both the lateral and medial sides are measured with two LVDT's fixed to the base and a pin through the tibia (Figure 2).

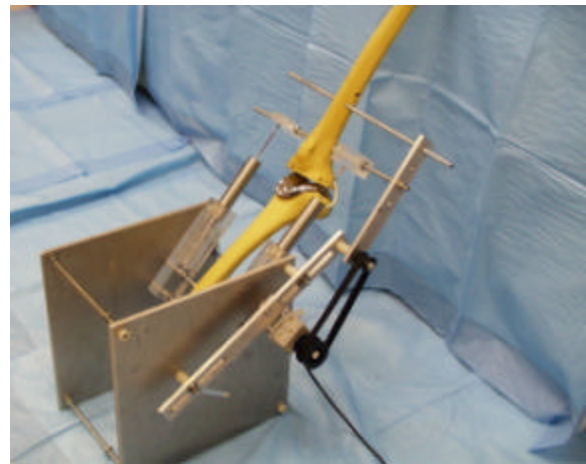


Figure 2 Femur Mounting Device

The cadaver femur is mounted to the base and initial measurements are taken between the femur and the tibia with the knee in full extension. The initial tibial cut is made and the joint space measuring device is inserted into the joint space. The measurements between the femur and the tibia are taken again and compared to the initial measurements. If the measurements differ, a second tibial cut is made at an angle to the first cut to correct for the difference. Once the measurements between the femur and the tibia are the same as the initial measurements the knee is flexed through its full range of motion and the displacement between the two condyles and the tibial plateau and the rotation of the knee is measured. If the soft tissue is properly balanced the displacement of both the lateral and femoral condyles will be the same.