THE EFFECT OF PARTIAL RELEASE OF THE POSTERIOR CRUCIATE LIGAMENT IN TOTAL KNEE ARTHROPLASTY

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Relevance to Musculoskeletal Condition: The effect of partial release of the posterior cruciate ligament (PCL) on kinematics in total knee arthroplasty (TKA) must be known to discuss retention of the PCL.

Introduction: It is still controversial whether the PCL should be retained or sacrificed at TKA. Excellent clinical results achieved with either option. Some authors have pointed out that the tension in the PCL tends to become abnormal after arthroplasties on deformed or contracted knees. Some surgeons perform a partial release of the PCL for tight knees and have reported the effects of this procedure on the stability, range of motion and clinical outcome. However, the relationship between partial release of the PCL and dynamic kinematics of implanted knee has never been investigated. This experimental study was undertaken to evaluate the effect of partial release of the PCL on TKA kinematics.

Materials and Methods: Four fresh-frozen cadaver knees were tested. All the soft tissues were removed except the capsule, ligaments and tendinous insertions of the muscles. The femur was clamped in a frame, and the tibia was allowed to move freely. TKA surgery was performed using the Genesis II implant and instrumentation (Smith & Nephew Richards, Memphis, TN). The distal femoral cut was made with 7° of valgus relative to the femoral anatomical axis, and the proximal tibial cut was made with a 3° posterior slope.

The knee motion after TKA was measured in three dimensions. The measurement system consisted of a photostereometric system and a computer model of the articular surfaces of the Genesis II components. Eight light emitting diodes (LED) were rigidly attached to the femoral and tibial components. The motions of LEDs were monitored in three dimensions at a rate of 100 Hz using 2 sets of 3 linear CCD cameras. By combining the surface model and LEDs motion data, the inter surface relationships of both components were obtained and the closest regions of medial and lateral condyle could be estimated. The centers of the closest regions were defined as the contact points. Motion was produced with a motion applicator that only controlled flexion/extension of the 6-degrees-of-freedom parameters of knee motion (Fig 1). An axial load was applied to the knee joint with 40 N of quadriceps tension and 20N of flexor tension.

The strain in the PCL was measured using curved force transducer implanted in the central part of the PCL. The PCL strain was measured from 0° to 90° of flexion.

For this experiment, flat insert with PCL retained was used. The tibial insert thickness was determined after checking knee joint function, to preserve the joint line. Measurements were made before the PCL was released. Then, a partial release of the PCL was performed. The tibial bone fragment of the PCL insertion was removed and the tibial insertion of the PCL was resected or contracted. The pattern of strain in the PCL in the partial release group was the same as that in the before release group. The maximum value of the PCL strain decreased to 81% of the value before release.

Discussion: The role of the PCL is to restrict posterior tibial translation, increase femoral rollback, and improve the range of motion. Many authors have pointed out that the PCL degenerates and loses normal elasticity in deformed or contracted knees. Abnormal PCL tension in TKA may produce abnormal kinematics and contribute to excessive posterior polyethylene wear. The results of this study revealed that partial release of the PCL decreased the tension in the PCL, but did not decrease the femoral rollback significantly. The pattern of femoral rollback after partial release was the same as that before release. These results suggest that partial release of the PCL would reduce over tightening of the PCL and prevent excessive femoral rollback and stress concentration on the posterior edge of the tibial insert.

Fig. 1. The measurement system (light emitting diodes and linear CCD camera)

Fig. 2. Anteroposterior translation of the femoral component

References

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