HOW PATELLAR EVERSION AFFECTS LIGAMENT BALANCING IN TKA

INTRODUCTION

Postoperative complications of Total Knee Arthroplasty (TKA) such as joint instability or component loosening can lead to premature wear or failure of the prosthetic joint. One recognized factor that influences these problems is the ligament imbalance. A misdistribution of the tibiofemoral contact forces can generate an overload of one compartment, which accelerates the wear process. Usually, the ligament balance is qualitatively assessed with manual trial movements and observation of tibiofemoral gaps or with invasive mechanical tools. Both approaches require a patellar eversion that may significantly modify the mediolateral force distribution and thereby alter the assessment of imbalance. The goal of the present study was therefore to estimate in terms of forces how patellar eversion affects ligament balancing in TKA.

METHOD

The study was performed on six human cadaver knees from donors with an average age of 82 years (63 to 90). The surgical preparation of each specimen consisted of the two first steps of TKA, i.e. accessing the joint with a medial parapatellar approach followed by the resection of the tibial plateau. A force-sensing device, which allows the measurement of the tibiofemoral contact forces [1], was then introduced (see Fig. 1).

Following that preparation, the specimen was mounted on a knee joint loading apparatus [2] that provides all the degrees of freedom needed for unconstrained knee motion and that allows the monitoring of the relative angular position between the femur and tibia. Quadriceps forces could be simulated by loading the patellar tendon with weights.

To evaluate the effect of patellar eversion on the mediolateral distribution of the contact forces, the patellar tendon was loaded with weights increasing from 1kg to 5kg at 0°, 30°, 60° and 90° flexion with and without a patellar eversion. The relative amounts of the applied load going through the medial and lateral compartments of the knee joint were measured and compared for each position and each condition (patella everted or not). As part of the load applied on the patella tendon was transmitted parallelly to the tibial plateau, the measurements were normalized by the perpendicular component to ensure comparable data.

The sum of the relative medially and laterally transferred loads then corresponds to 100%. The statistical significance was determined with a sign test for paired samples.

RESULTS

The mediolateral load distribution did not vary considerably with knee flexion (standard deviations ranged from 3% to 8%), therefore the laterally transferred loads were averaged over the different knee positions. The mediolateral distribution of the patellar load was significantly different (p=0.03) when the patella was in its anatomical place or not: one fourth of the patellar load was shifted from the medial to the lateral side with a patellar eversion (Fig. 2). Additionally, it can be noted that the patella in its anatomical place already influenced the mediolateral distribution of the contact forces since the average laterally transferred load was 62% without a patellar eversion.

DISCUSSION

Patellar eversion had a significant influence on the mediolateral distribution of the condyle contact forces. One fourth of the patellar load was shifted to the lateral compartment. Although this influence is intuitive, it is the first time according to the authors’ knowledge that the effect is quantified in terms of forces. Only one recent study [3] compared the influence of the patellar eversion and subluxation to the physiological situation in terms of angular variation. With a given interarticular load of 150N for the medial and lateral side, the patellar eversion increased the leg axis by 2.9° valgus. Although a quantitative comparison to the present study is not possible, the measured effects are qualitatively consistent. Finally, the fact that the patella in its anatomical place already influenced the mediolateral distribution of the contact forces could be due to a non-symmetrical contact area between the patella and the femoral trochlea or due to the medial incision of the knee joint.

In conclusion, surgical approaches that allow the patella to be kept in its anatomical place during the ligament balancing procedure should be adopted in order to ensure reliable intraoperative assessment of knee instability.

REFERENCES


AFFILIATED INSTITUTIONS

** Laboratoire de Systèmes Robotiques, Ecole Polytechnique Fédérale de Lausanne, Switzerland
*** Department of Orthopaedic Surgery, Inselspital, University of Bern, Switzerland
**** Laboratoire de Production Microtechnique, Ecole Polytechnique Fédérale de Lausanne, Switzerland
***** Institute for Orthopaedic Research and Biomechanics, University of Ulm, Germany

Fig. 1: The force-sensing device, which allows the measurement of the tibiofemoral contact forces and which is placed in the knee joint after the tibial cut. The device consists of two sensitive plates instrumented with piezoresistive sensors and a tibial base plate, which is fixed by pins.

Fig. 2: Relative laterally transferred loads. One fourth of the patellar load was shifted from the medial to the lateral side with a patellar eversion. The grey and black horizontal lines correspond to the average values.

52nd Annual Meeting of the Orthopaedic Research Society

Paper No: 0581