Raising the joint line in TKA causes significant mid-flexion instability.

T Luyckx1*, H Vandenneucker1, E Vereecke2, L Scheys1, A. Victor, J Victor3

1Department of Orthopaedic Surgery, University Hospitals Leuven, Pellenberg, BELGLUM
2Department of Development & Regeneration, University of Leuven campus Kulak, Kortrijk, BELGLUM
3Department of Orthopaedic Surgery & Traumatology, University Hospital Ghent, Ghent, Belgium

* Corresponding author:
Thomas Luyckx
University Hospitals Leuven
Weligerveld 1
3212 Pellenberg

thomas.luyckx@uzleuven.be
Tel +3216338070
Fax +32473967200
Abstract

Background

Restoring the joint line at its original level is a prerequisite for a good functional outcome after total knee arthroplasty (TKA). However, in the case of a flexion contracture or a tight extension space, many surgeons will deliberately raise the joint line to obtain full extension. The biomechanical effect of raising the joint line remains poorly understood.

Purpose

The purpose of this study was to investigate the effect of joint line elevation in TKA on the varus/valgus stability of the knee, throughout the flexion arc.

Methods

A TKA was implanted in 10 fresh frozen cadaveric knees in an optimal position (TKA0), i.e. with restoration of the medial joint line at its original level by performing a 9 mm distal and posterior femoral cut. Coronal plane stability was measured at 0°, 30°, 60°, 90° and 120° of flexion using a navigation system (Brainlab, Feldkirchen, Germany) while applying an instrumented 9.8 Nm varus and valgus torque. Afterwards, the joint line was raised in two steps by re-cutting the distal and posterior femur by an extra 2 mm (TKA2) and 4 mm (TKA4) and respectively adding a 2 and 4 mm thicker insert.

Secondly, a simplified two-dimensional mathematical model based on a single flexion-extension axis was developed to simulate the effect of raising the joint line on the isometry of the superficial medial collateral ligament (sMCL) of the knee.

Results

No significant differences were observed in coronal plane laxity between the normal knee and the TKA implanted in the ‘normal’ position (fig. 1).
After TKA, no differences were observed in extension between the normal and the 2 mm and 4 mm raised joint line. In mid-flexion (30° and 60°) however, a significant increase in coronal plane laxity was observed for the TKA2 and TKA4 position (fig. 2). The first distal re-cut of + 2 mm (TKA2) increased overall coronal plane laxity by on average 64% (3.1°) at 30° of flexion (p<0.01) and 51% (3.0°) at 60° of flexion (p=0.02). Performing the second + 2 mm re-cut (TKA4) of the distal femur increased the mid-flexion laxity by 111% (5.4°) (p<0.01) at 30° and 95% (5.5°) at 60° of flexion (p<0.01) compared to the 9 mm baseline resection (TKA0). At 90° and 120°, no significant differences were observed between the 3 groups.

From a linear regression model, it was calculated that for every millimetre rise in joint line level, a 31% increase in coronal plane laxity at 30° and a 25% increase at 60° can be expected.

The geometrical model was consistent with the cadaveric findings and predicted a slackening of the sMCL in the mid-flexion range and tightening of the sMCL in deeper flexion.

**Conclusion**

Restoration of the medial joint line reproduces normal sMCL isometry and joint stability in TKA. Raising the medial joint line causes significant mid-flexion instability and tightness in deeper flexion despite a well-balanced flexion and extension gap.
Figures

Fig 1: Mean coronal plane laxity in degrees is presented for each flexion angle. Results for the native knee and the TKA with the restored joint line are shown. No statistical significant differences were noted between the native knee and the TKA with the restored joint line (TKA0). Error bars indicate the standard deviation.

Fig 2: Coronal plane laxity in degrees is presented for each flexion angle. Results for the TKA with the restored joint line (TKA0), the 2mm (TKA2) and 4mm (TKA4) raised joint line are shown. No statistical significant differences were noted between the 3 groups in extension or at 90° and 120° of flexion. However, a significant increase in coronal plane laxity was seen at 30° and 60° of flexion.