ABSTRACT

**Purpose.** To assess the effect of each step of medial soft-tissue releases on the joint gap angle during posterior-stabilised total knee arthroplasty (TKA).

**Methods.** 82 women and 9 men (mean age, 72 years) with medial osteoarthritic knees underwent 100 posterior-stabilised TKAs, in which release of superficial fibres of the medial collateral ligament (MCL) were required using the gap control technique. The order of releases was the superficial MCL, the pes anserinus, and then the semi-membranosus. The superficial MCL was released selectively. The effect of each step of medial soft-tissue releases in full extension and in 90º flexion was compared.

**Results.** After all medial soft-tissue releases, the mean joint gap angles decreased from 8.7º to 3.8º varus in flexion and from 4.4º to 1.4º varus in extension. The total effect of medial soft-tissue releases was significantly larger in flexion than in extension (4.9º±3.2º vs. 3.0º±2.0º, p<0.0001), except for the release of posterior fibres of the superficial MCL. The effect of release of the semi-membranosus in flexion was largest.

**Conclusion.** The release effect was significantly greater in flexion than in extension during posterior-stabilised TKA; the joint gap technique may be more reliable in medial osteoarthritic knees with moderate and severe varus instability.

**Key words:** arthroplasty, replacement, knee; medial collateral ligament, knee

Effect of medial soft-tissue releases during posterior-stabilised total knee arthroplasty

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INTRODUCTION

Soft-tissue balancing by releasing ligaments and tendons is important for the success of total knee arthroplasty (TKA).1–14 Little is known about the effect of each step of medial soft-tissue releases both in full extension and in 90º flexion in varus medial osteoarthritic knees during posterior-stabilised TKA. Resection of the posterior cruciate ligament increases the flexion gap.11,15–17 Findings of soft-tissue release in cruciate-retaining TKA may not be applicable to posterior-stabilised TKA. In cadaveric studies, the
release of the pes anserinus and semi-membranosus tendons cannot be assessed. We therefore assessed the effect of each step of medial soft-tissue releases on the joint gap angle both in full extension and in 90° flexion during posterior-stabilised TKA, using a gap control technique.\textsuperscript{10,18} We hypothesised that the effect of medial soft-tissue release differ because the direction of soft tissues vary between extension and flexion.

**MATERIALS AND METHODS**

Between April 2003 and March 2005, 82 women and 9 men (mean age, 72 years) with medial osteoarthritic knees underwent 100 posterior-stabilised TKAs, in which release of superficial fibres of the medial collateral ligament (MCL) was required using the gap control technique. The medial femorotibial joint space had disappeared in all cases. All TKAs were performed by a single surgeon. This study was approved by our Institutional Review Board. Informed consent of each patient was obtained.

First, the distal femur and the proximal tibia were cut. All osteophytes were removed. The cruciate ligaments were excised, and the deep fibres of the MCL and medial posterior capsule were released. The medial edge of the tibial condyle that was not covered with the tibial tray was also removed. The femorotibial joint was distracted with a force of 30 inch-pounds using a tensor/balancer device (Fig. 1), and the joint gap angles between femoral and tibial cut surfaces in extension, and between the posterior condylar line and the tibial cut surface at 90° knee flexion were measured (Fig. 2).\textsuperscript{10,18} The knee balancer has units of 0°, 3°, 6°, 9°, and 12° in varus and valgus. The degrees between units were measured by a ruler.

The feet were positioned at 90° knee flexion. Medial soft tissues were then released until the joint gap angle in extension was ≤3° varus, which was the case in 20 knees before the release. These knees were included because their joint gap angle in flexion was >7° varus and release of superficial fibres of the MCL was required. The order of releases was the superficial MCL, the pes anserinus, and then the semi-membranosus. The superficial MCL was released selectively according to the Whiteside technique.\textsuperscript{6,7} The anterior fibres of the superficial MCL were released first in knees with tight flexion (i.e. the 20 knees with a joint gap angle in extension of ≤3° varus). On the contrary, the posterior fibres of the superficial MCL were released first in knees with tight extension. Tight flexion was defined as when the angle between the posterior condylar line and the tibial cut surface at 90° knee flexion was >3° larger than the angle between femoral and tibial cut surfaces in extension. The joint gap angle was assessed after each step of the medial soft-tissue releases.

The joint space was then set equal between extension and flexion, and the anterior and posterior cuts of the femur were made. The mean joint gap angle was 0.8° varus in extension and 0.3° valgus in flexion (Fig. 2). The femorotibial angle on the standing radiograph improved from 187.1° (5.1° varus) to 175.6° (4.4° valgus).

The patellae were everted in all measurements.\textsuperscript{12–14} The patellofemoral joint contact pressure differed between extension and flexion. Therefore, when the joint gap angle was compared between extension and flexion, the patella should be everted.\textsuperscript{5,12–14,18} The effect of each step of medial soft-tissue releases in extension and flexion was compared, using paired t-tests. A p value of <0.05 was considered statistically significant.

**Figure 1** The femorotibial joint is distracted using a tensor/balancer device for assessing the joint gap angle and distance.

**Figure 2** The joint gap angle and distance are measured in extension and in flexion (a) before and (b) after the medial soft-tissue releases and the anterior and posterior cuts of the femur.
After all medial soft-tissue releases, the mean joint gap angles decreased from 8.7º to 3.8º varus in flexion and from 4.4º to 1.4º varus in extension. The total effect of medial soft-tissue releases was significantly larger in flexion than in extension (4.9º±3.2º vs. 3.0º±2.0º, p<0.0001, Fig. 3), except for the release of the posterior fibres of the superficial MCL. The effect of release of the semi-membranosus in flexion was largest. After the release of the superficial MCL (including selective releases), subsequent release was performed up to the pes anserinus in 27 cases and up to the semi-membranosus in 8 cases. In selective superficial MCL releases, anterior fibre release was performed in 58 cases, and additional posterior fibre release in 30 cases. Whereas posterior fibre release was performed in 42 cases, and additional anterior fibre release in 31 cases.

DISCUSSION

After excision of the posterior cruciate ligament, hamstring muscles (including the gastrocnemius muscles) are tight in extension and loose in flexion. The direction of each soft tissue differs between extension and flexion. These may explain the larger effect of the medial soft-tissue releases in flexion. Our findings regarding posterior-stabilised TKA may not be applicable to cruciate-retaining TKA, because excision of the posterior cruciate ligament significantly influences the joint gap angle in flexion.6,11,15–17

Theoretically, release of the semi-membranosus is effective mainly in extension because the fibres run perpendicular to the femorotibial joint in extension and parallel to the femorotibial joint in flexion. However, after excision of the posterior cruciate ligament, the joint gap in flexion becomes wider, and the effect of release of the semi-membranosus becomes larger. Great care should be taken when the semi-membranosus is released during posterior-stabilised TKA.

In the selective release of the superficial MCL, posterior fibres of the superficial MCL induce moderate laxity in extension.6 In our study, release of the posterior fibres alone produced a larger (though not significantly) effect in extension than in flexion. The effect of release of the anterior fibres alone or in addition was significantly larger in flexion than in extension.

In the gap control technique, the joint gap angle and distance are assessed before the anterior and posterior cuts of the femur both in extension and in flexion. The external rotation angle of the anterior and posterior cuts relative to the posterior condylar line is determined based on the joint gap angle in flexion. If the joint gap angle in extension is larger than that in flexion after distal femoral and proximal tibial cuts, soft-tissue balancing is difficult to attain because the release effect of medial soft tissues is larger in flexion. In such cases, modification of the operative techniques or a constrained knee system may become necessary.

In the measured resection technique (in which distal and anterior and posterior cuts of the femur are performed before medial soft-tissue releases), the knees may have instability in flexion after medial soft-tissue releases during posterior-stabilised TKA. The joint gap technique may be more reliable in medial osteoarthritic knees with moderate and severe varus instability.

REFERENCES