PRIMARY TOTAL KNEE ARTHROPLASTY IN THE VALGUS KNEE: CREATING A BALANCED SOFT TISSUE ENVELOPE

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Introduction
Valgus-deformity correction presents a complex challenge in total knee arthroplasty (TKA). Optimal clinical outcomes require a balanced soft tissue envelope that often necessitates release of contracted lateral structures. Lateral soft tissue-release sequences frequently produce asymmetrical flexion/extension-gaps and can produce ligamentous instability.

Goal
This study sought to quantify the effects of sequential release of lateral capsular ligamentous structures and compare two specific lateral-release sequences with regard to their ability to produce symmetrical flexion/extension gaps.

Hypothesis
The hypothesis of this study is that release of specific lateral soft tissue structures asymmetrically affects the flexion and extension gaps; release sequence B produces more symmetrical flexion/extension gaps than sequence A.

Materials and Methods
Seven-paired knees were placed in a testing platform (Figure 1) underwent the standard measured resection cuts for a primary TKA. The knees then received one of two serial lateral-release sequences. One knee from each pair was released according to sequence-A (four-step sequence): 1. Posterior cruciate ligament (PCL), 2. Iliotibial tract (IT band), 3. popliteus tendon/lateral collateral ligament (PT/LCL) and 4. biceps femoris tendon. The contralateral knee was released via sequence-B (five-step sequence): 1. PCL, 2. posterolateral capsule, 3. IT band, 4. PT, and 5. LCL. Following each release-step, flexion and extension gaps were documented for the medial and lateral compartments.

Resection of the femur and tibia produced flexion and extension gaps defined as follows: 1) Flexion Gap- the distance between the cut surface of the proximal tibial and the posterior condylar surface of the femur with the knee in 90° of flexion, 2) Extension Gap- the distance between the proximal tibial surface and the distal femoral surface with the knee in extension.

The leg was manually distracted in 90° of flexion and 0° of extension using the stainless steel tibial rod. Flexion and extension gap measurements taken from the reference marks were recorded to the nearest millimeter for the medial and lateral aspects of the knee using a hand held digital caliper (SR-44, Mitutoyo, Tokyo, Japan). Each measurement was repeated three times beginning with the unreleased knee and then for each subsequent soft tissue release providing six measurements in flexion and six measurements in extension.

Results
Releases were compared for flexion and extension gaps on both the medial and lateral aspects of the knee. For release steps in either sequence there were no significant difference in the magnitude of flexion or extension gap increase for measurements taken from the medial compartment of the knee. Sequence-A produced asymmetrical flexion/extension gaps. For example, transverse joint-line IT-band release created asymmetrical lateral compartment increases in the flexion and extension gaps, 2.9 ±1.2 mm and 7.8 ±2.9 mm respectively (p< 0.001). Conversely, release of PT/LCL from the femur increased the flexion-gap (14.0 ±3.0 mm) more than the extension-gap 1.8-mm ±1.0 (p<0.001). Release sequence-B more symmetrically affected the flexion/extension gaps, until femoral LCL release, which increased the flexion-gap (12.3±4.0mm) more than the extension gap (2.6±1.6mm) (p<0.001).

Conclusion
Although sequence-B produced more symmetrical flexion/extension gaps the absolute magnitudes of correction were lower than with sequence-A. In contrast, sequence-A produced greater increases in the flexion/extension gaps than did sequence-B with consequent flexion/extension asymmetry. LCL sacrifice in both sequences demonstrated marked lateral flexion/extension gap asymmetry, indicating LCL takedown should be avoided if at all possible.