

Increased Medial Soft Tissue Distractibility with Increasing Varus Deformity with High Variability in Total Knee Arthroplasty

Introduction

- Kinematic Total Knee Arthroplasty (TKA) technique proposes that a balanced TKA can be produced by simply reproducing the native anatomy without the need for ligament releases.
- However, the anatomy of the knee is complex and highly variable.
- The purpose of this study is to evaluate the in vivo medial and lateral ligament tensions of the knee across various limb alignment categories.

Methods

- Using ligament tensions acquired during 805 robotic assisted TKA with a dynamic ligament tensor under a load of 70–90N, the relationship between medial and lateral collateral ligament laxity and overall limb alignment was established.
- Only knees with neutral or mechanical varus alignment were included and divided into 5 groups: neutral (0–3°), varus 3–5°, varus 6–9°, varus 10–13°, and varus ≥14°.
- Groups were further subdivided by the native tibial coronal angle (TCA) and native femoral coronal angle (FCA).
- The distraction of the medial and lateral sides was compared across the various alignments using an analysis of variance.

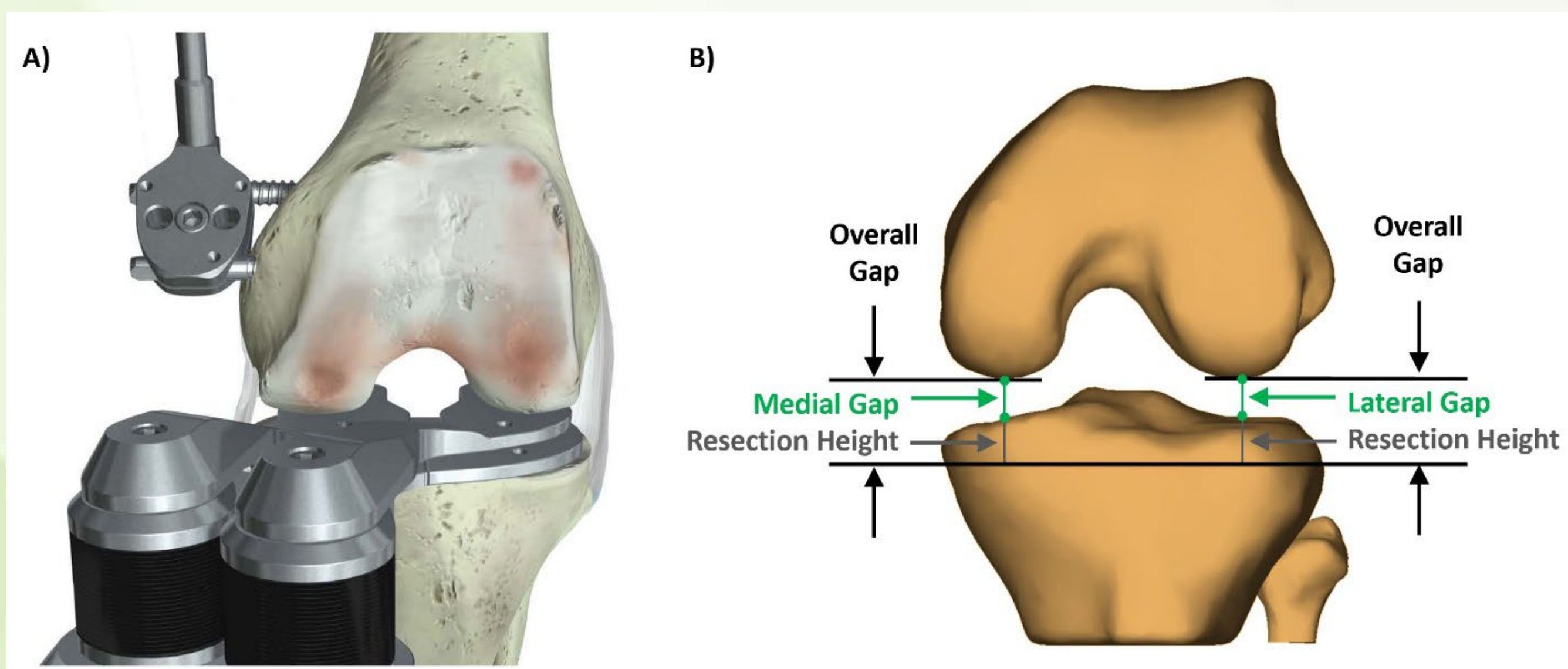
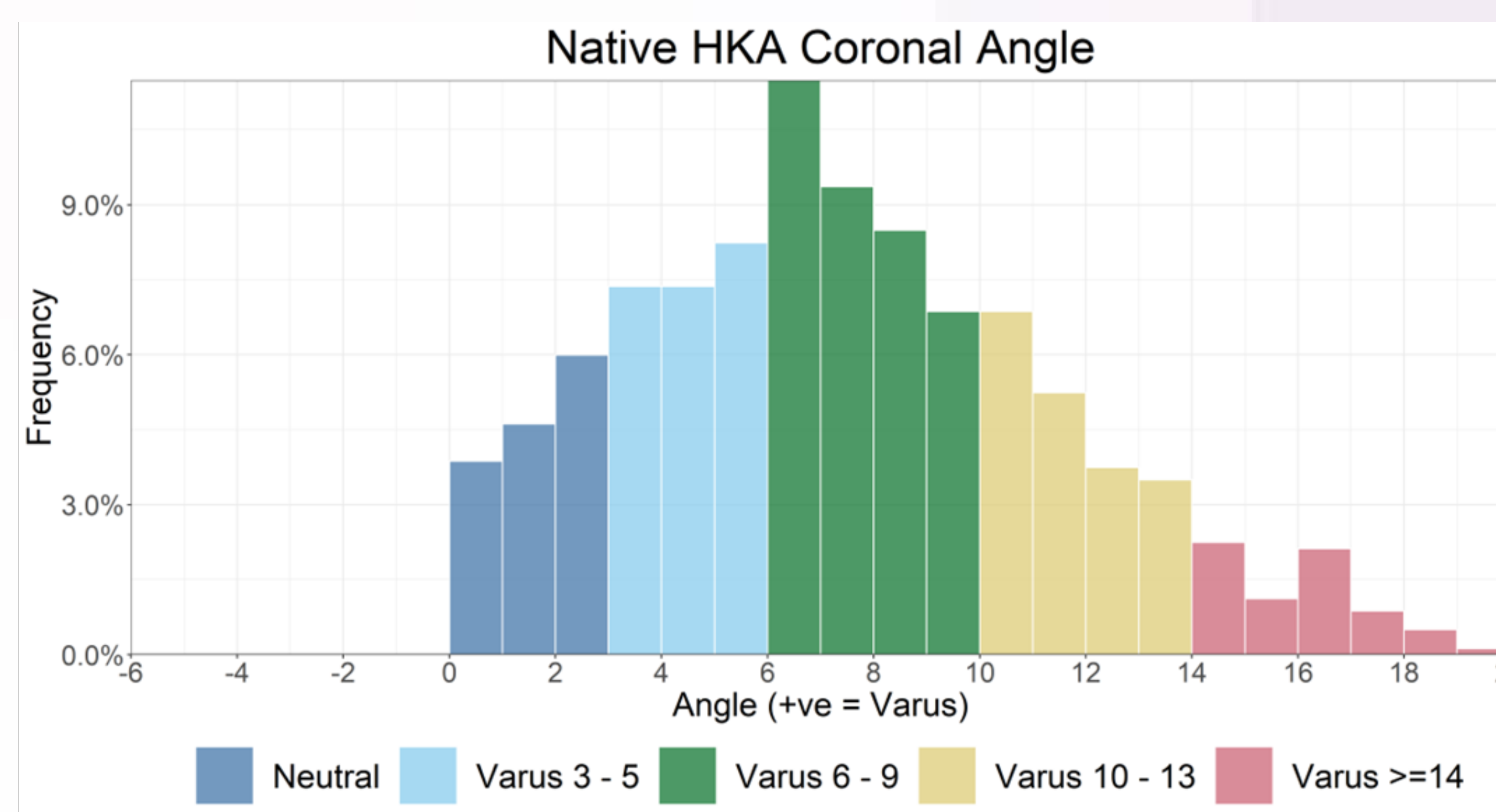


Figure 1 a) A digital ligament tensioning device was inserted into the joint after tibial resection and the medial and lateral (overall) gaps were measured throughout the range of motion with 70–90N of distraction force applied per side. b) Distractibility of the medial and lateral gaps was calculated as the overall gap minus the tibial resection thickness on the medial and lateral sides.



| | Neutral 0 – 3° | Varus 3 – 5° | Varus 6 – 10° | Varus 10 – 14° | Varus > 14° |
|--------------|----------------|--------------|---------------|----------------|-------------|
| No. of Knees | 116 | 184 | 290 | 155 | 60 |

Figure 2 Distribution of knees according to hip-knee-ankle (HKA) alignment and number of knees within each alignment category. In total, 805 knees were included.

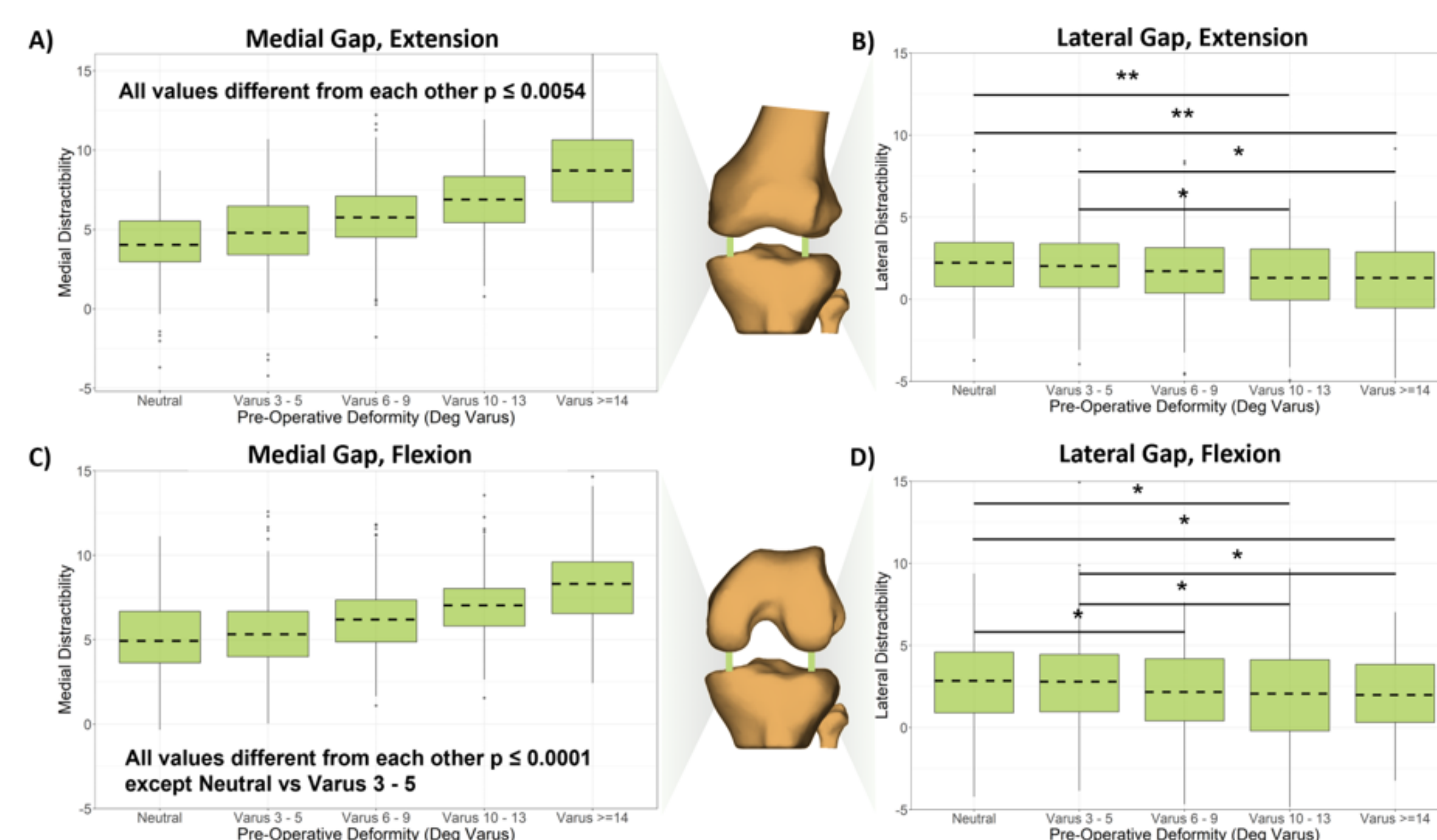


Figure 3 Distractibility (mm) across varus deformity groups in extension on the medial (a) and lateral (b) sides, and in flexion on the medial (c) and lateral (d) sides

Results

- The ability to distract the medial collateral ligament in extension and flexion was proportional to the degree of varus deformity, increasing from 4.0±2.3 mm in the neutral group to 8.7±3.2 mm in the varus ≥14° group (p < 0.0001).
- On the lateral side, the distraction of the lateral collateral ligament decreased in both extension (2.2±2.4 vs 1.2±2.7, p<0.0001) and flexion (2.8±2.8 to 1.7±3.0, p<0.0001).
- TCA and FCA had similar effects, where increasing TCA varus and FCA valgus increased medial distractibility in extension and flexion. There was significant variability of the stretch of the ligaments within and across all alignment categories, in which the standard deviation of the groups ranged from 2.0 to 3.0 mm.

Conclusions

- This study demonstrates increased medial ligament distractibility with increasing varus deformity.
- However, there was significant variability in ligamentous laxity within various limb alignment categories suggesting the anatomy and soft tissue identity of the knee is complex and highly variable.
- TKAs seeking to be more anatomic will not only need to restore alignment but also native soft tissue tensions.
- Targeting alignment alone may result in a TKA that is unbalanced and prone to early failure.