Valgus Versus Varus Knees: What’s the Difference?

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INTRODUCTION: Severe valgus knee deformity is a challenge in primary total knee arthroplasty (TKA). Valgus knees are associated with increased difficulty in component positioning/soft tissue balance, and worse clinical outcomes when compared to their varus counterparts. Traditional teaching is that lateral condyle hypoplasia is one of the key differences between valgus and varus knees. The hypothesis for this study is that there is minimal difference in condylar height between varus and valgus knees. The purpose of this study was to use computed tomography (CT) and conventional long leg radiographs to evaluate differences in femoral rotation, femoral condyle height, and tibial angulation of varus and valgus knees.

METHODS: This was a single institution retrospective study of patients who had primary TKA by 4 orthopedic surgeons for osteoarthritis between 8/2016-8/2023 with preoperative lower extremity CT scans and full leg length radiographs. Inclusion criteria were patients who had >5°of varus or valgus hip-knee-ankle (HKA) angle as measured on full leg length radiographs. HKA angle >0° was defined as varus, and HKA angle <0° was defined as valgus. Tibial bowing angle was measured and considered significant if ≥3°. Total medial and lateral femoral condyle height, as well as the height above and below the trans-epicondylar axis was measured on axial CT scans of the knee. Femoral version was measured as the angle between the proximal femoral neck and the distal posterior femoral condylar axis on axial CT scans of the hip and knee. Normal femoral neck anteversion was defined as 0-20°, excessive anteversion was defined as >20°, and femoral neck retroversion was defined was <0°. Measurements were performed by three different observers: attending orthopedic surgeon, attending musculoskeletal radiologist, and resident orthopedic surgeon.

RESULTS: In total, 44 valgus knees and 65 varus knees were included in this study. 47.7% of valgus knees had significant valgus tibial shaft bowing (≥3°) compared to only 3% of varus knees (*P*<0.01). The average femoral version for valgus knees was 5.5° ± 12.2°, compared to 10.4° ± 6.8° for varus knees (*P*=0.02). In valgus knees, 55% had femoral version within normal range (0-20°), compared to 89% of varus knees (*P*<0.01). Additionally, 34% of valgus knees had femoral retroversion (<0°) compared to 3% of varus knees (*P*<0.01). Lastly, 11% of valgus knees and 9% of varus knees had excessive femoral anteversion (>20°). There were no significant differences in medial or lateral femoral condyle height between groups.

DISCUSSION AND CONCLUSION: In this study we found that valgus knee alignment is associated with decreased femoral version and increased tibial valgus bowing. These factors may lead to lateral knee compartment overload and development of lateral compartment arthritis. Notably, we found that valgus knee alignment was not associated with lateral condyle hypoplasia. These findings have implications for component placement during TKA primary and revision surgery. We believe that during TKA surgery when the knee is flexed to 90 degrees, femoral retroversion contributes to the appearance of lateral condyle deficiency.

	Valgus	Varus	P-value
Hip-Knee-Ankle Angle	-11.5° ± 4.4°	9.0° ± 3.3°	**<0.01**
Significant Tibial Bowing (≥3°)	21 (47.7%)	2 (3.0%)	**<0.01**

	Valgus	Varus	P-value
Femoral Neck Version	5.5° ± 12.2°	10.4° ± 6.8°	**0.02**
Normal Anteversion (0-20°)	24 (55%)	55 (89%)	**<0.01**
Excessive Anteversion (>20°)	5 (11%)	6 (9%)	0.72
Retroversion (<0°)	15 (34%)	2 (3%)	**<0.01**
Medial Femoral Condyle Height (mm)	60.6 ± 4.5	60.5 ± 5.1	0.89
Height Above TEA (mm)	31.3 ± 3.0	31.0 ± 3.1	
Height Below TEA (mm)	29.4 ± 2.5	29.5 ± 2.7	
Lateral Femoral Condyle Height (mm)	62.1 ± 3.9	60.9 ± 5.0	0.18
Height Above TEA (mm)	37.8 ±2.4	35.6 ± 3.7	
Height Below TEA (mm)	24.2 ± 2.4	25.3 ± 2.8	