

# Is the Location of the Tibial Wear Cavity Associated with Internal-External Rotation of the Tibia in the Non-Weight Bearing Osteoarthritic Knee?



Derrick S. Ross, BS<sup>1</sup>, Alexander J. Nedopil, MD<sup>1</sup>, Stephen M. Howell, MD<sup>1,2</sup>, Mohamed R. Mahfouz, PhD<sup>3</sup>, Maury L. Hull, PhD<sup>1</sup>

<sup>1</sup>University of California, Davis, Davis, CA; <sup>2</sup>Methodist Hospital, Sacramento, CA; <sup>3</sup>University of Tennessee, Knoxville, TN



## INTRODUCTION

A study of computer tomograms (CT) showed that the tibia of twenty-four osteoarthritic (OA) knees had 5° more external rotation on the femur than the native knee and suggested that this rotation should be systematically corrected when aligning a total knee arthroplasty (TKA)<sup>1</sup>. It is unknown whether the femoral condyle settles in the tibial wear cavity in the non-weight bearing OA knee and whether the anterior-posterior (A-P) location of tibial wear into which the femur settles causes the tibia to rotate on the femur. Accordingly, we determined the prevalence with which the femoral condyle settles in the tibial wear cavity and whether the center of the A-P location of the tibial wear cavity is associated with internal-external rotation (I-E) of the tibia on the femur.

## METHOD

**1** On the MRI of 150 OA knees treated with TKA, we identified the more worn tibial condyle (Figure 1 A). A femoral condyle which was not settled in the tibial wear cavity had joint fluid between the surfaces (Figure 1 B). A femoral condyle which was settled in the tibial wear cavity showed direct contact between the surfaces (Figure 1 C).

**2** The center of the A-P location of tibial wear was categorized in each knee as anterior-medial (n = 57), central-medial (n = 36), posterior-medial (n = 21), central-lateral (n = 13), or posterior-lateral (n = 23) (Figure 2).

**3** The I-E rotation of the tibia was determined in each knee (Figure 3).

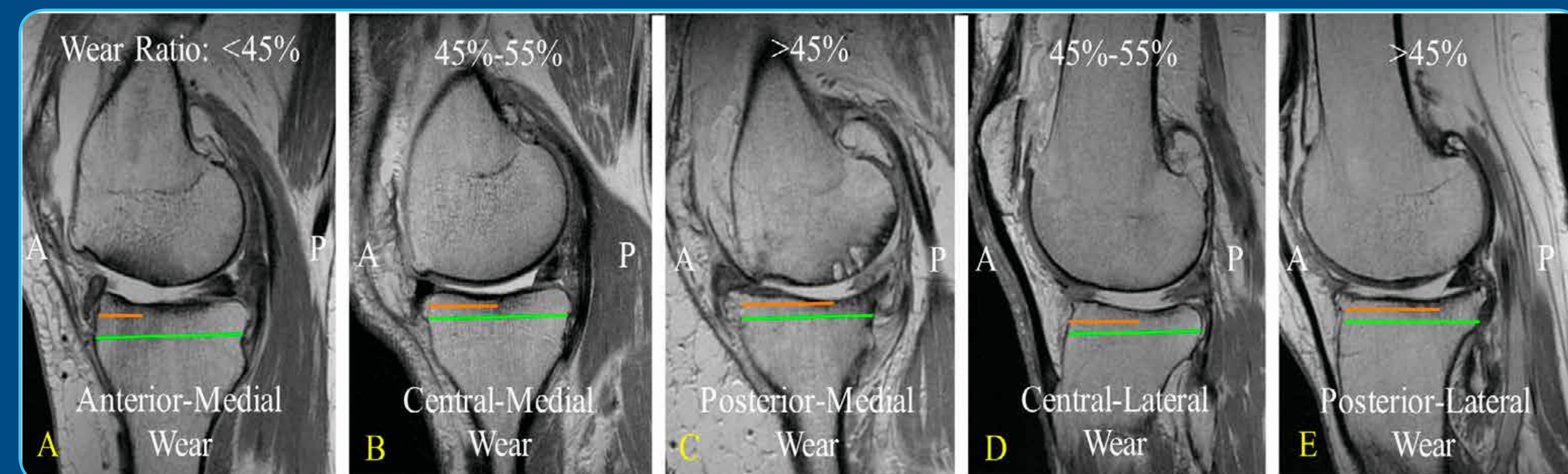
**4** Settling of the femoral condyle in the tibial wear cavity was recorded by determining whether the femoral condyle contacted the bottom of the tibial wear cavity. Contact between the femoral condyle and tibial wear cavity was recorded as yes if no joint fluid was present between the bottom of the femoral condyle and the tibial wear cavity or no if joint fluid was present.



**Figure 1.** The composite of three sagittal magnetic resonance imaging scans shows an example of the more worn tibial condyle (A), no settling of the femoral condyle into the tibial wear cavity with joint fluid (white) present between the bottom of the

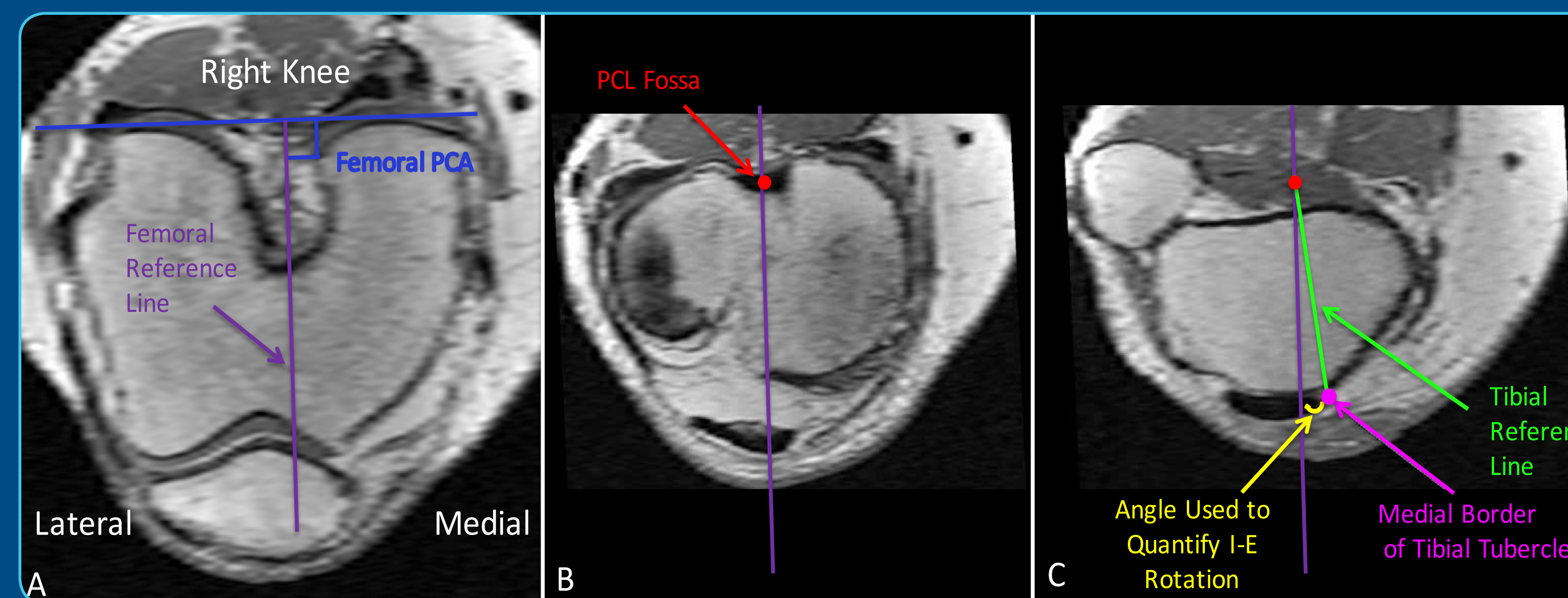
femoral condyle and tibial wear cavity (B), and settling of the femoral condyle into the tibial wear cavity with no joint fluid present (C).

**5** A one-factor analysis of variance and post hoc Tukey's test determined whether I-E rotation of the tibia on the femur was different between each category of A-P location of tibial wear (five levels).



**Figure 2.** The composite shows five sagittal magnetic resonance imaging (MRI) scans of non-weight bearing osteoarthritic knees with five categories of tibial wear. The ratio,

expressed as a percentage, of the measurement of the length of a line drawn parallel to the tibial plateau from the anterior edge to the posterior edge of the tibia (green) and measurement of the length of a line from the anterior edge of the tibia to the center of tibial wear (orange) categorized the A-P location of tibial wear.



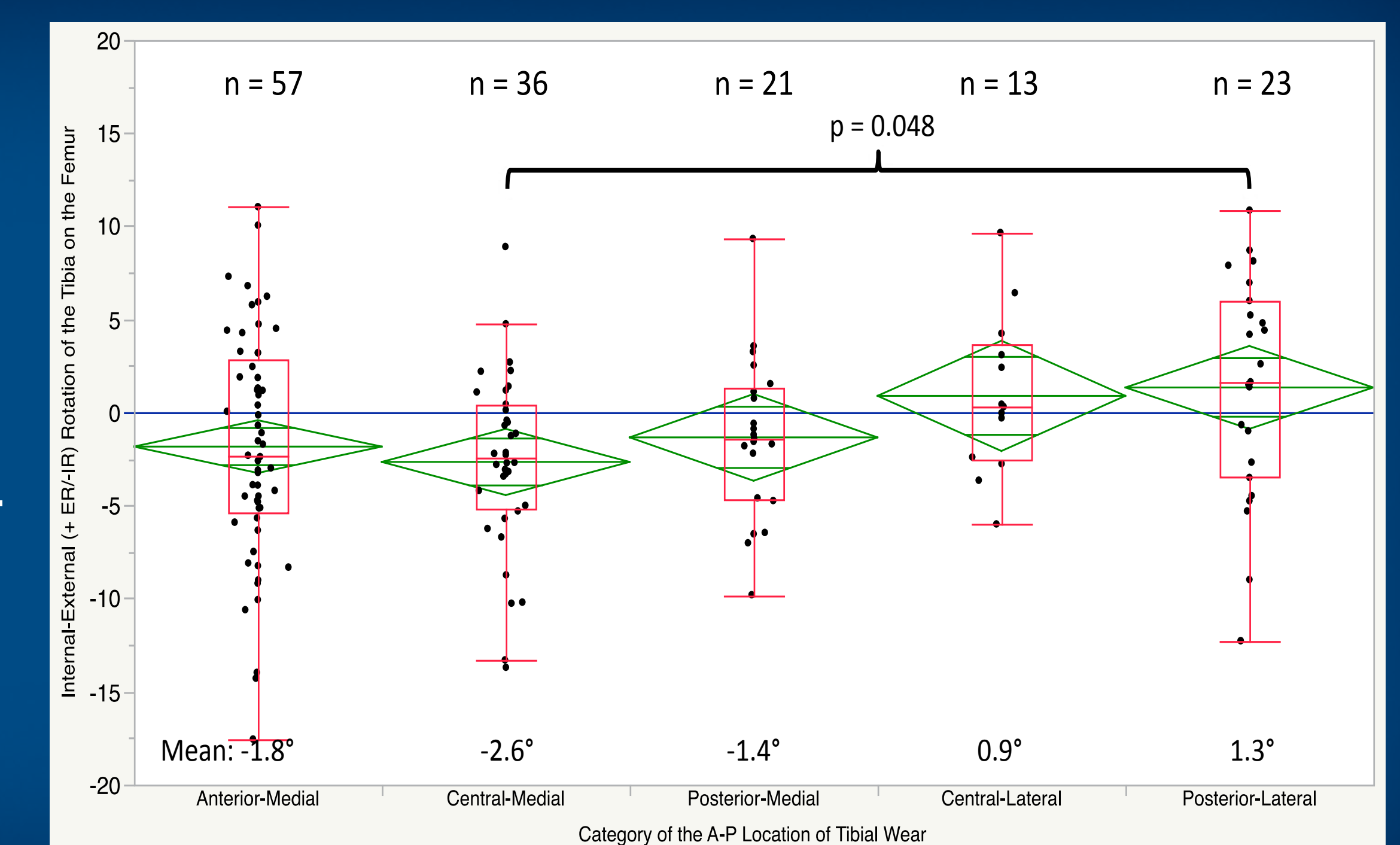
**Figure 3.** The composite of three axial views of an MRI of a right osteoarthritic knee shows the femoral reference line (purple), the tibial reference line (green), and the angle between the two reference lines (yellow) used to compute the

I-E rotation of the tibia on the femur. The angle formed by the femoral and tibial reference lines minus 90° determined the internal (-) or external (+) rotation of the tibia on the femur.

## RESULTS

Eighty-nine percent (134 of 150 knees) of the knees did not show the femoral condyle settling into the tibial wear cavity. Nine of the ten comparisons between the five categories of tibial wear showed no significant difference in the mean I-E rotation of the tibia between the categories of the A-P location of tibial wear ( $p > 0.125$ ). There was a 4° difference in the I-E rotation between the central-medial and posterior-lateral location of tibial wear ( $p = 0.048$ ).

**Figure 4.** A box plot shows the measurements of the I-E rotation of the tibia on the femur for the osteoarthritic knees with five categories of tibial wear. The diamonds (green) illustrate the mean and 95% confidence interval. Only the I-E rotation between the central-medial and posterior-lateral groups showed a 4° difference ( $p = 0.048$ ) and the rest of the group pairings were not different ( $p > 0.125$ ).



## DISCUSSION

The general lack of settling of the femur into the tibial wear cavity and the lack of difference in I-E rotation between the categories of tibial wear do not support performing a systematic correction of 5° of external rotation of the tibia when planning a patient-specific, robotic, or navigational total knee arthroplasty on the OA knee.