Factors Affecting Final Sagittal Alignment In Robotic Total Knee Replacement

George Jacob, MBBS, MS Ortho, FAOrthA,
Yoong Lim, BEng, PhD,
David A. Parker, MBBS, BMedSc, FRACS,

Landmark Orthopaedics
The (Knee) Institute
Sydney Orthopaedic Research Institute

Declaration of Interest

One or more Authors have the following Declarations

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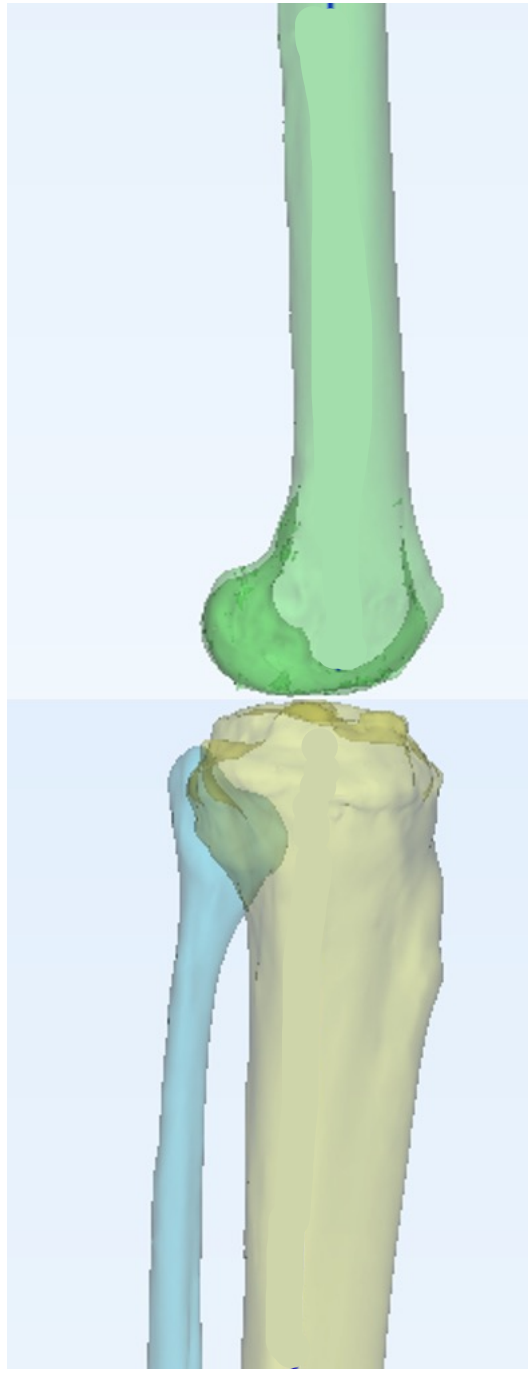
Navigation technology (NAV) in TKA appears to have sagittal plane discrepancy
NAV overestimates component flexion[1,2,3]

AIM

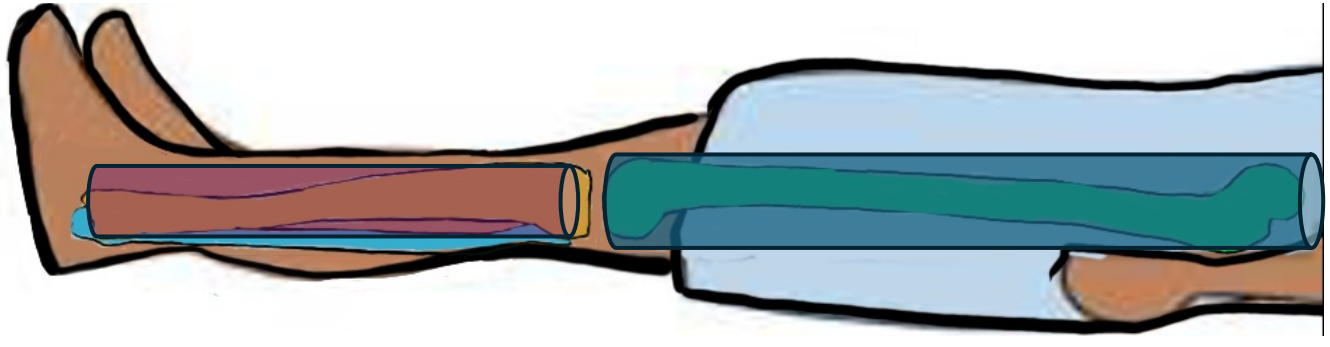
- Determine & Quantify the disparity between the NAV axis and Intra medullary (IM) axis
  - Study the effects of anatomical variations
  - Determine the effects of modifying intra articular (IA) reference points



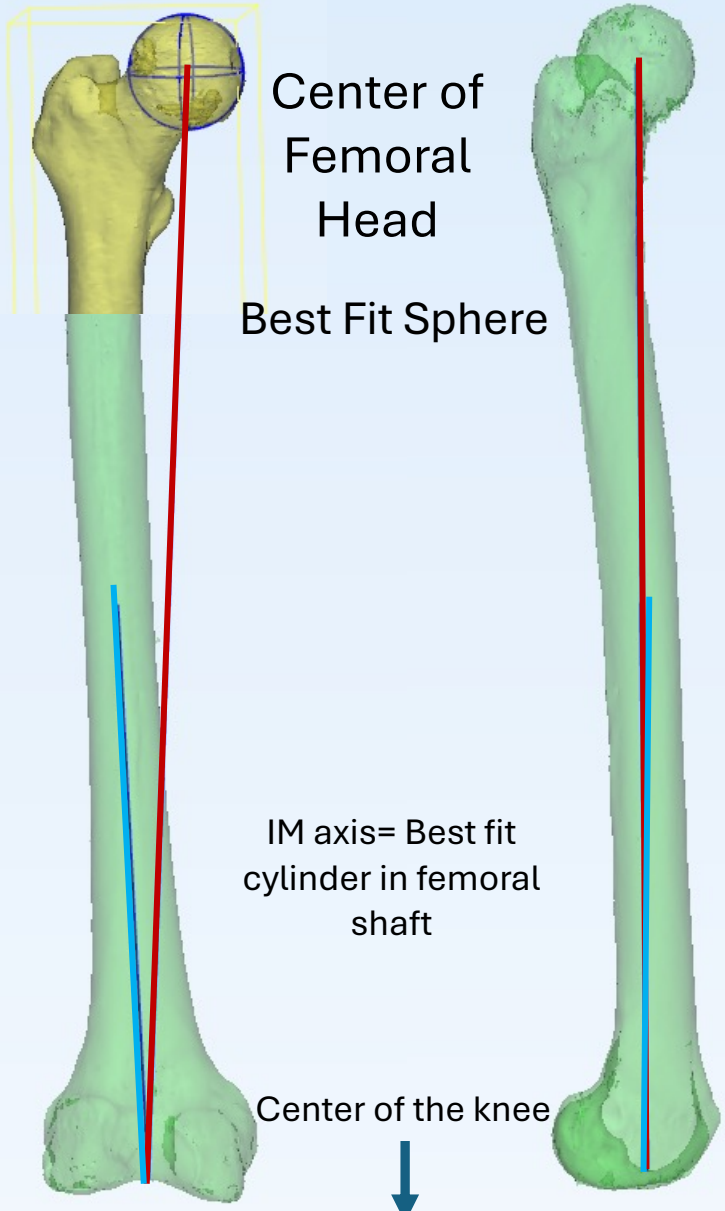
Methods

- 30 Pre-operative HTO Lower limb CT Scans used to develop 3D geometry of the femur and tibia using Mimics (Materialise, Leuven, Belgium)
- NAV axis and IM Axis drawn in each model
- Effect of variations in bony anatomy and plotting different IA points studied

- Clinically straight was defined as when the thigh and shin considered as two separate cylinders are in line with each other



Virtual Axes



Center of Femoral Head

Best Fit Sphere

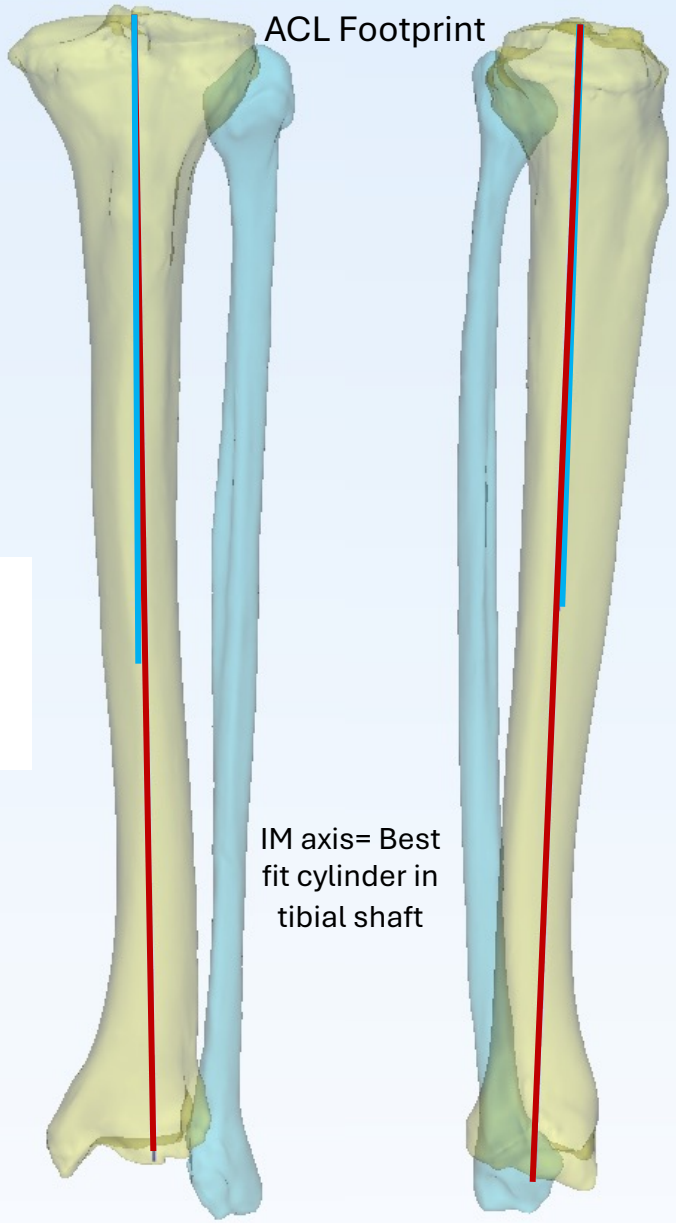
IM axis= Best fit cylinder in femoral shaft

Center of the knee

(Lowest point of Trochlea in Coronal and Sag Plane Centre of Intercondylar notch)

NA

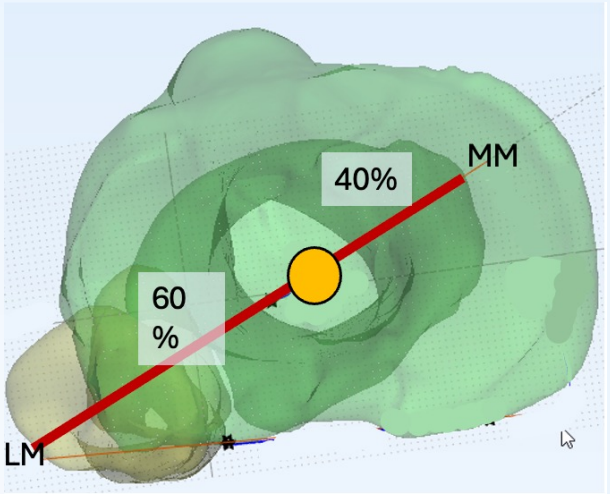
IM



ACL Footprint

IM axis= Best fit cylinder in tibial shaft

Line connecting the lateral and medial malleolus, favouring 60% medially



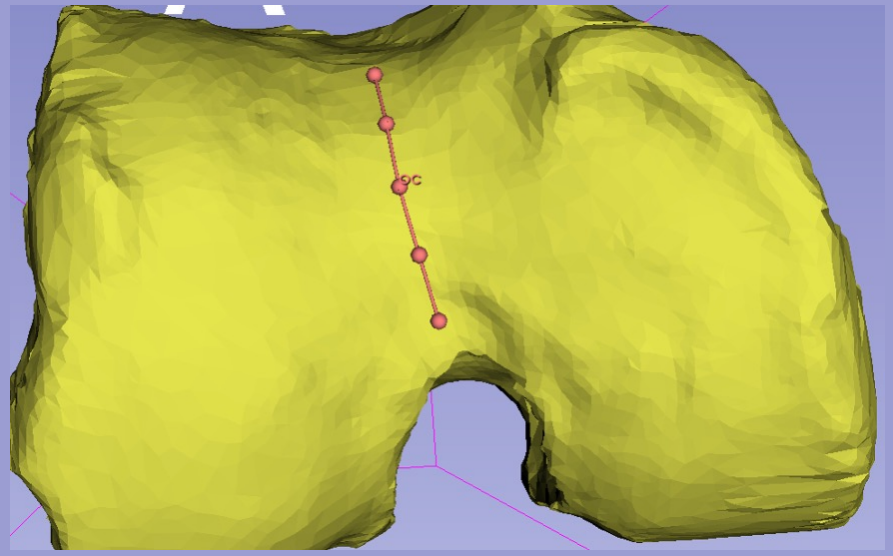
Variations in Anatomy

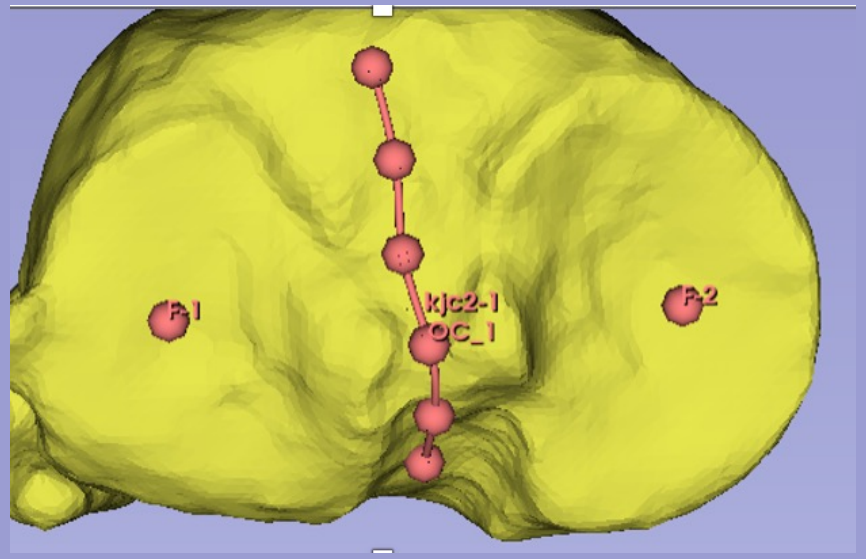
- Femoral Bow
- Tibial Bow
- Femoral Anteversion
- Tibial Torsion

Measured virtually using standard published methods [3,4]

Variation of IA Points

Distal Femoral & Proximal Tibial points were moved anteriorly and posteriorly

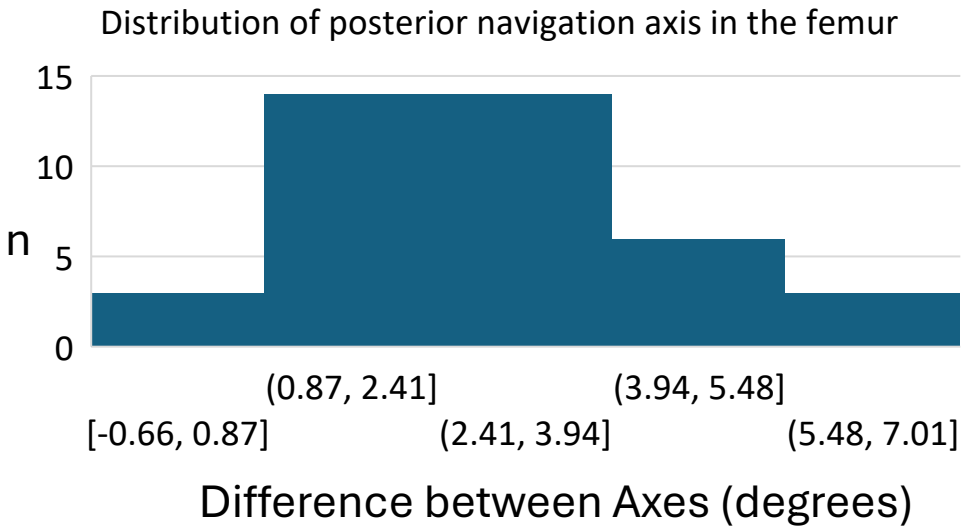




Results

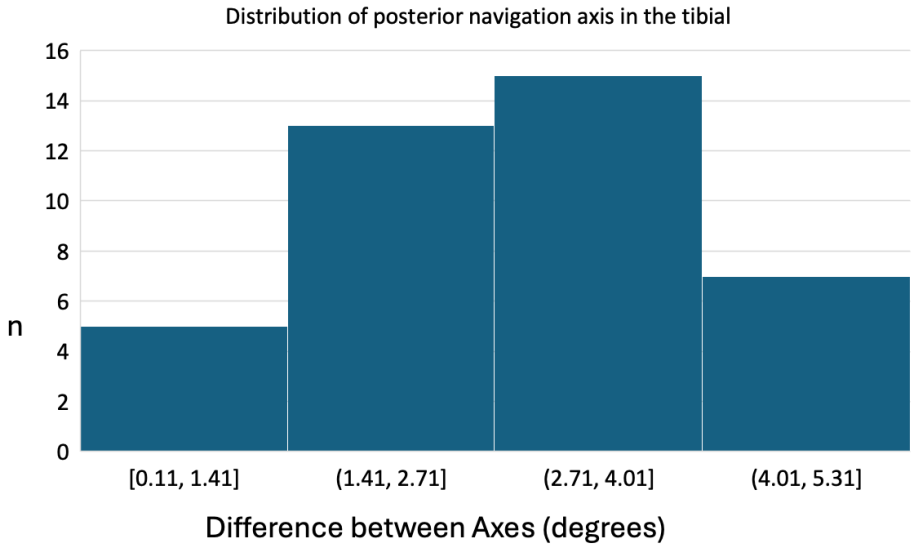
Femur

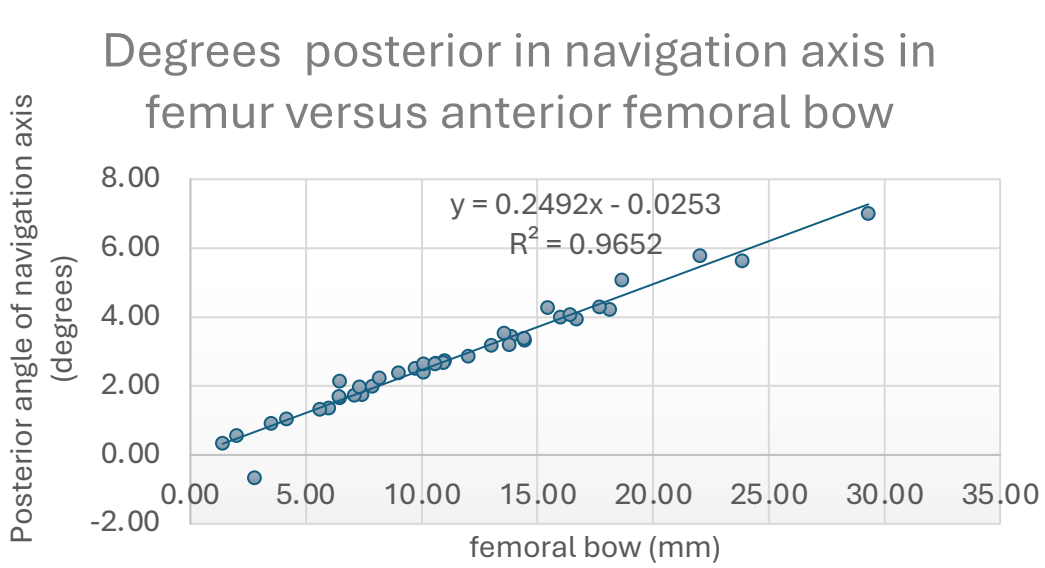
On Average NAV Axis remained posterior to the IM Axis by **2.9º±1.7º**

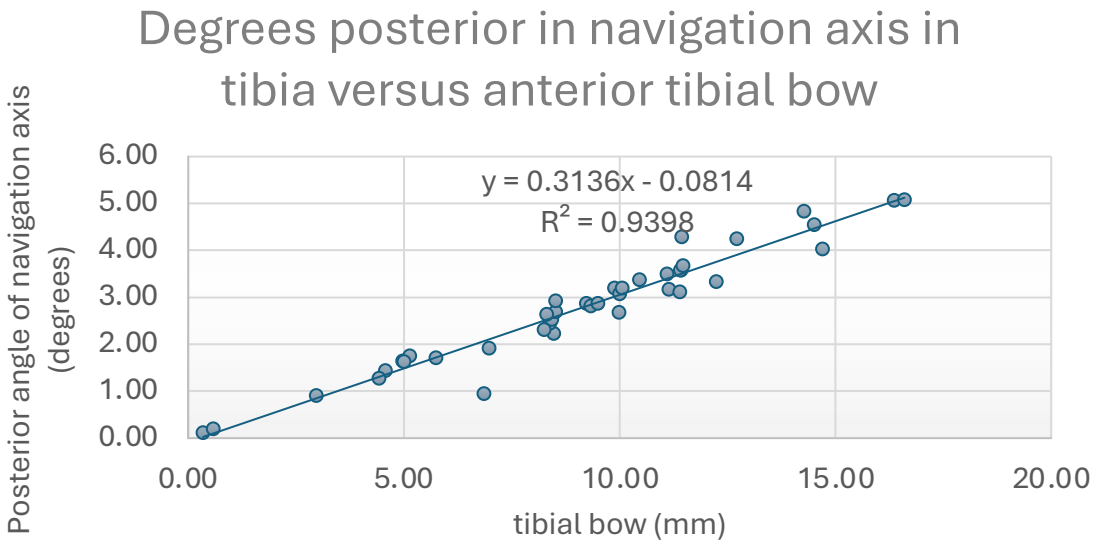


Tibia

On Average NAV Axis remained posterior to the IM Axis by **2.6º±1.3º**

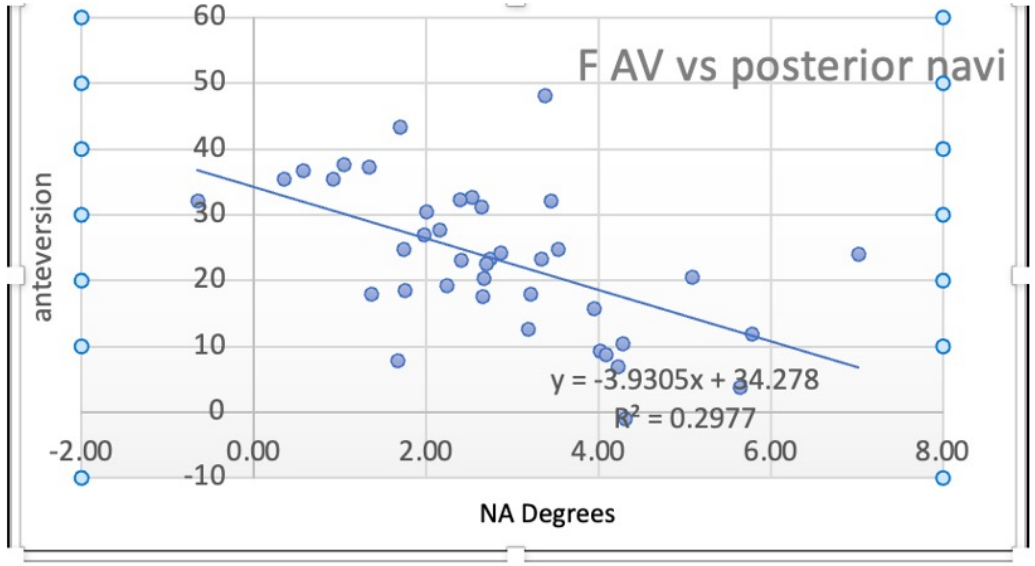




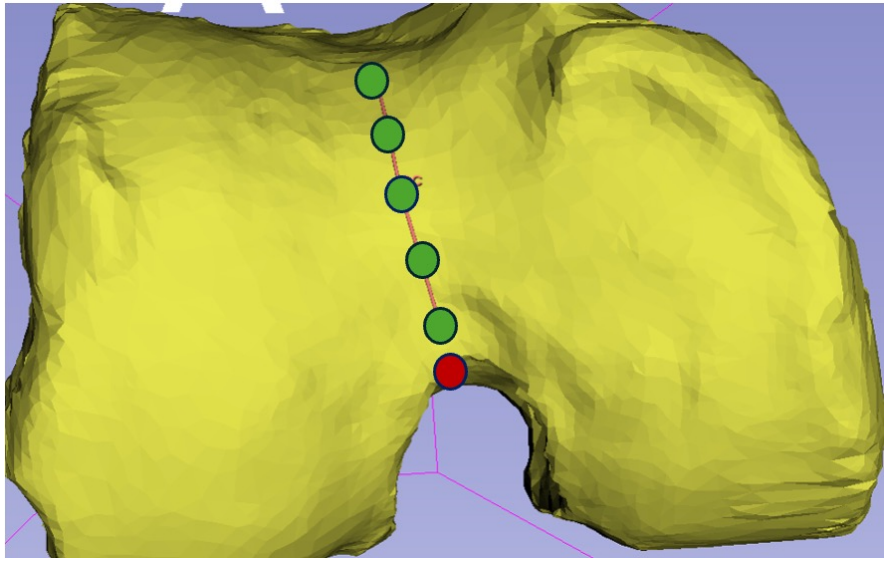


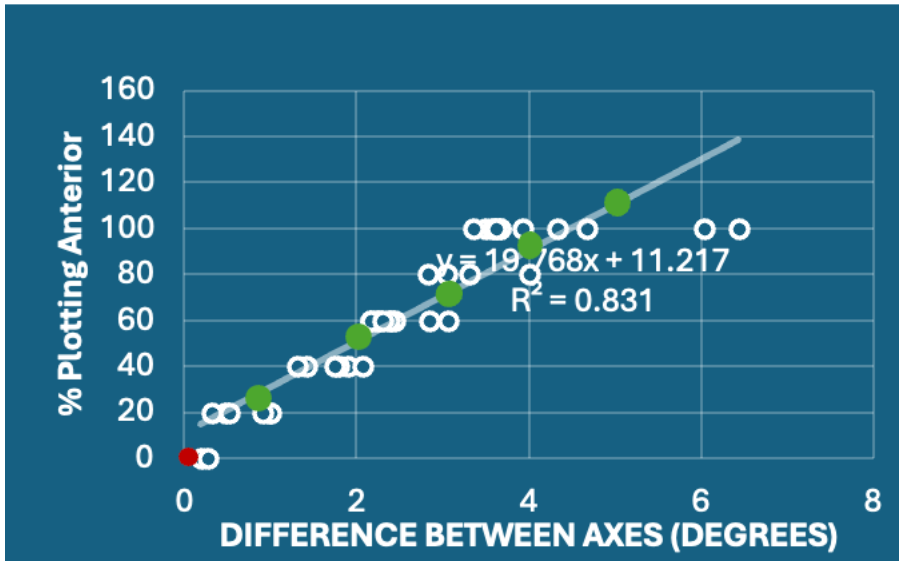
- > Anterior Femoral & Tibial bow = ↑ the difference (Anteriorized the Anatomy)

- Increased Femoral Anteversion ↓ the difference
- Tibial Torsion made no significant difference

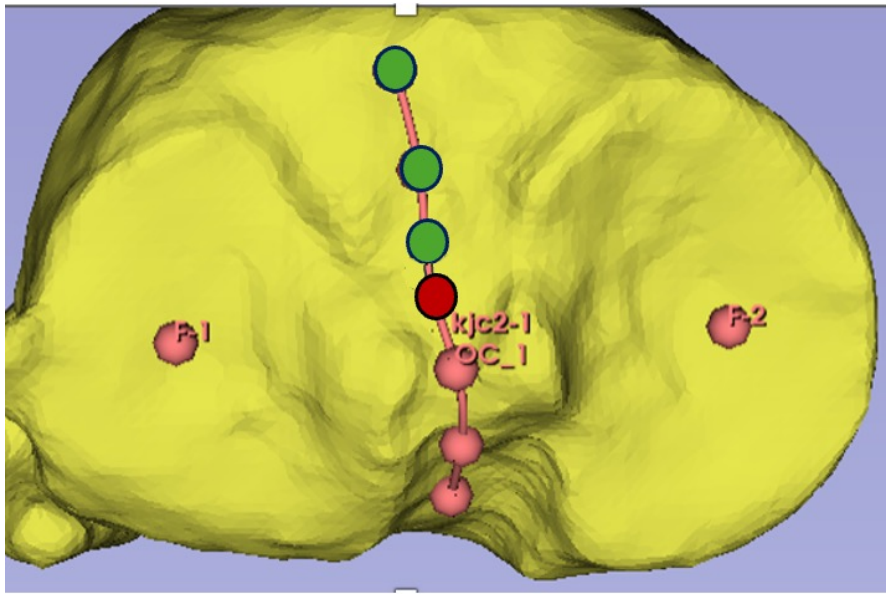


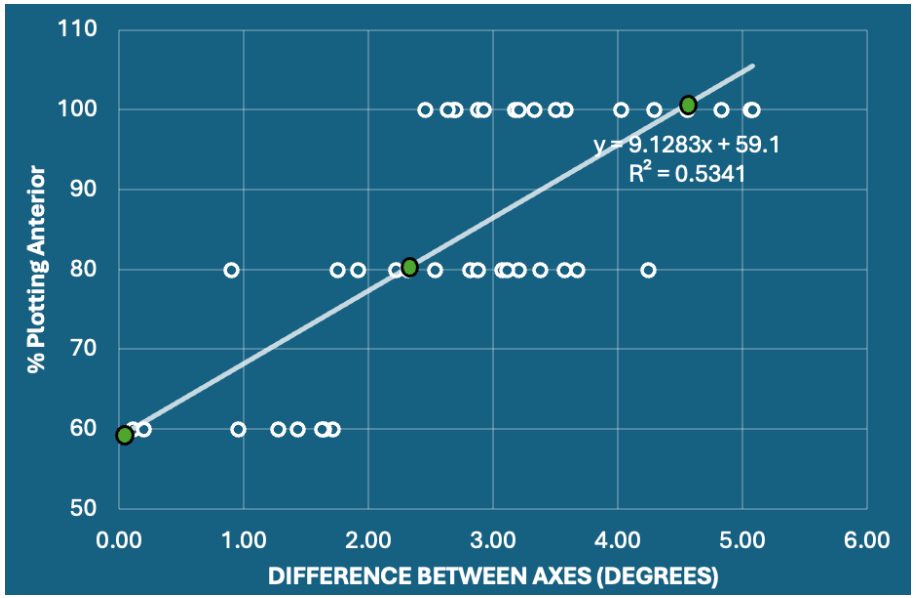
Effect of moving the Intra articular points





20% Anterior ≈ 1 degree correction





20% Anterior ≈ 1 degree correction

Limitations

- This is a virtual analysis of a clinical scenario
- We assume the AA axis stays in the center of the femoral canal (IM Rod may not)
- Defined centre of the knee for both axes (Surgeon Preference)
- Nav Systems and Algorithms may differ
- No consensus on clinical def on full extension

Summary

- Nav Axis was always posterior to the Intra Medullary Axis
- On average NAV overestimated
  - Femur Flexion by 2.9 degrees
  - Tibial Slope by 2.6 degrees

5.5 º Flexion (Nav) = 0 º IM Axis

Surgeons should be aware of anatomical variations preoperatively to understand axes discrepancy, Modifying IA Nav points can correct the axes discrepancy

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