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Extreme Hinge Axis Positions Are Necessary to Achieve Posterior Tibial Slope Reduction With Small Coronal-Plane Corrections in Medial Opening Wedge High Tibial Osteotomy

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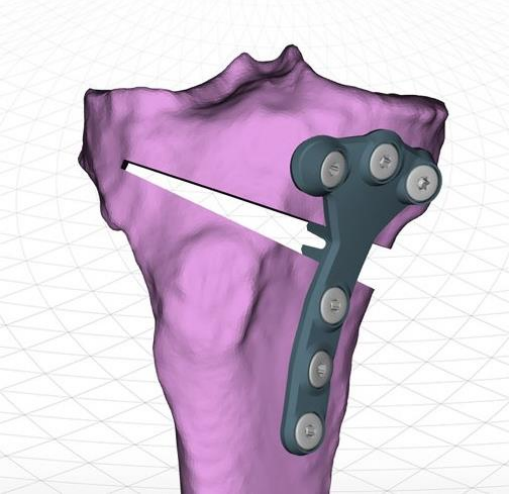

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Introduction

- Both **coronal-** and **sagittal-plane** knee malalignment can increase the risk of ligamentous injuries and the progression of OA.

- High tibial osteotomy (HTO) can achieve multiplanar correction, but determining the **precise hinge axis position** for osteotomy is technically challenging.

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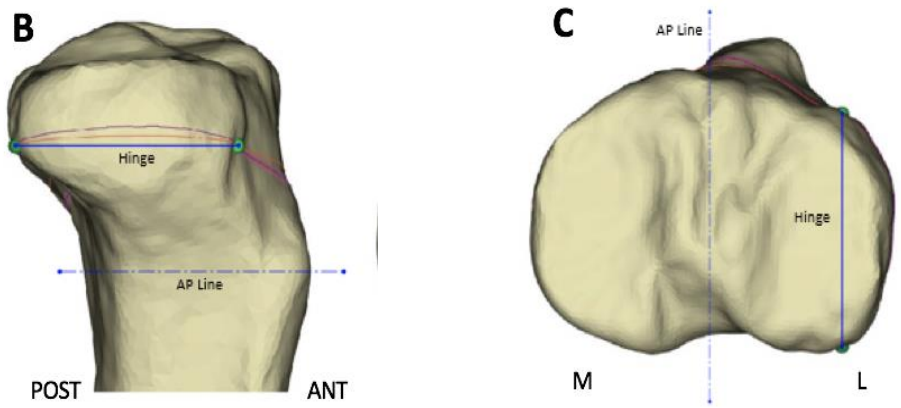
Purpose

To create CT–based patient-specific models to identify the **ideal hinge axis position angle** and the amount of **maximum opening** in medial opening wedge high tibial osteotomy (MOWHTO) required to achieve the desired multiplanar correction.



Materials and Methods

- **A total of 10 patients with lower extremity CT scans**

- **Baseline measurements**
  - Mechanical tibiofemoral angle (mTFA)
  - The posterior tibial slope (PTS)

- **Virtual osteotomy was performed to achieve**
  - (1) a specified degree of PTS correction
  - (2) a planned degree of mTFA correction

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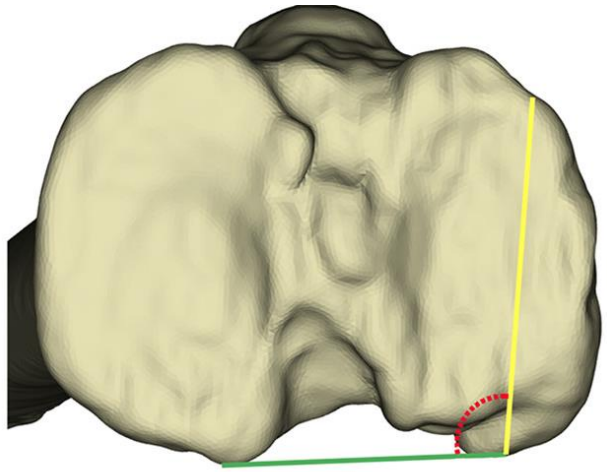
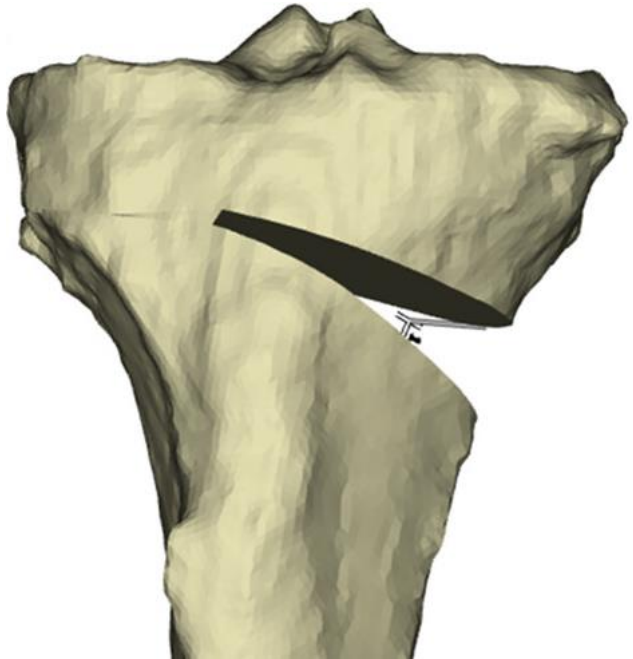
Materials and Methods

- The mean hinge axis position angle [red angle] for MOWHTO to maintain an anatomic PTS (no slope correction) was **102.6 ± 8.3** relative to the posterior condylar axis (PCA) [green line]



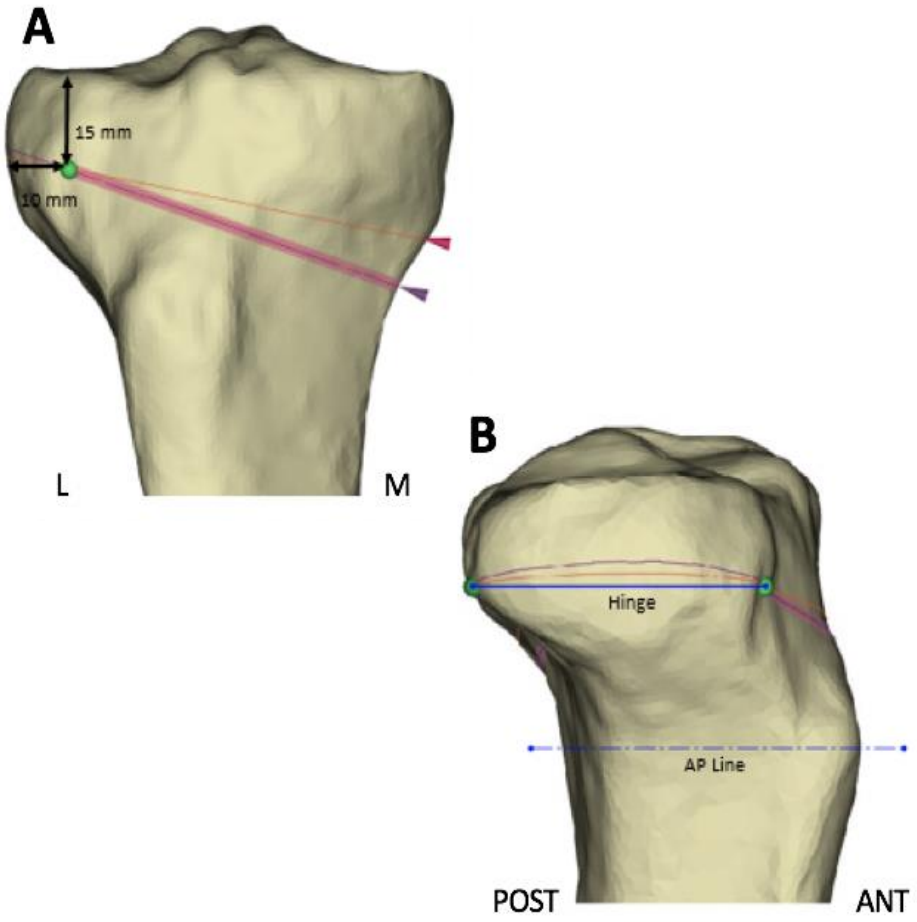
- Using this as the **baseline correction**, the resultant hinge axis position and maximum opening were then calculated for each subsequent osteotomy procedure.



Results: Demographic

10 patients

- 4 males/6 females
- Mean age was 57 years (49-66 years)
- Mean mTFA of 8.1° ± 3.2° (3.6°-13.4°)
- Mean PTS was 9.5° ± 1.8° (7.2°-12.3°)



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Results

- **5.0°, 7.5°, 10.0°, 12.5°, and 15.0° of mTFA correction (PTS consistent)**

	mTFA Correction				
	5.0°	**7.5°**	**10.0°**	**12.5°**	**15.0°**
Maximum opening, mm	7.2	9.7	12.3	14.9	17.5
Hinge axis position, deg	102.6	102.6	102.6	102.6	102.6
PTS, deg	9.5	9.5	9.5	9.5	9.5

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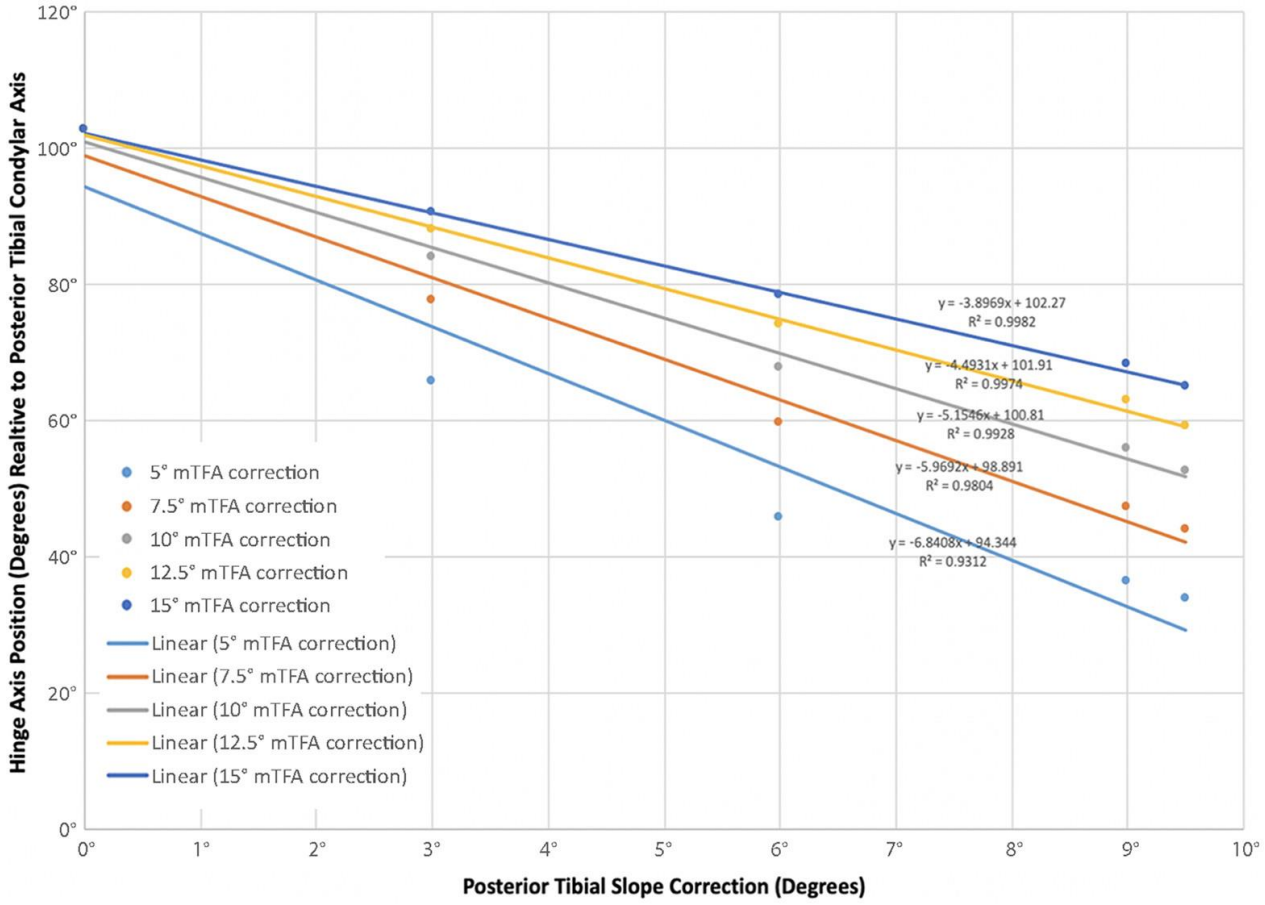
Results: Hinge axis position angle required for posterior tibial slope correction



- **For 5º of mTFA correction**
  - The hinge axis position was decreased by 6.8º
- **For 10º of mTFA correction**
  - The hinge axis position was decreased by 5.2º
- **For 15º of mTFA correction**
  - The hinge axis position was decreased by 3.9º

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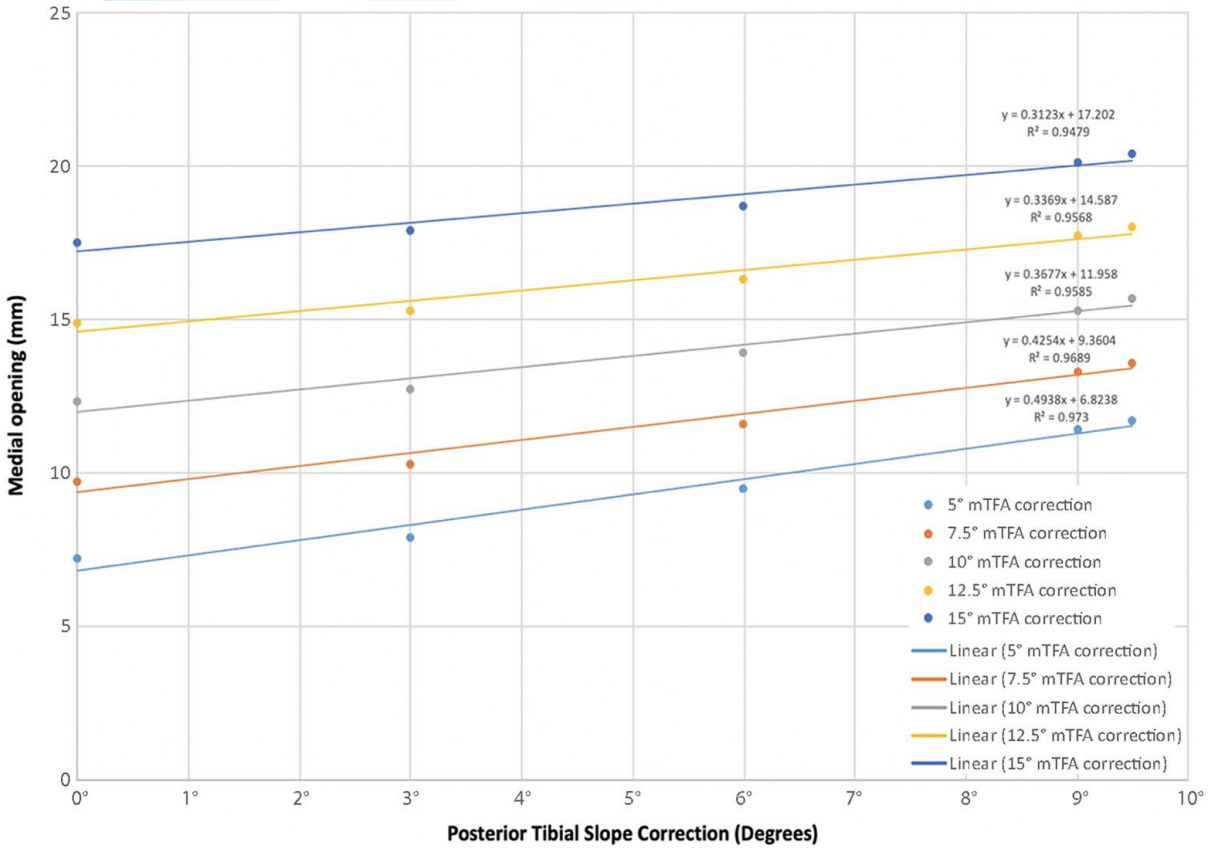
Results: Amount of maximum opening required for posterior tibial slope correction



- **For 5º of mTFA correction**
  - The maximum opening was increased by **0.49 mm for every 1º** of PTS correction
- **For 10º of mTFA correction**
  - The maximum opening was increased by **0.37 mm for every 1º** of PTS correction.
- **For 15º of mTFA correction**
  - The maximum opening was increased by **0.31 mm for every 1º** of PTS correction.

Discussion

Our finding

- The ideal hinge axis position angle for MOWHTO to maintain an anatomic PTS (no slope correction) was a mean of **102.6° ± 8.3°**
- With smaller coronal-plane corrections**, more extreme (more internally rotated) hinge axis positions** were necessary to achieve the same degree of PTS correction.

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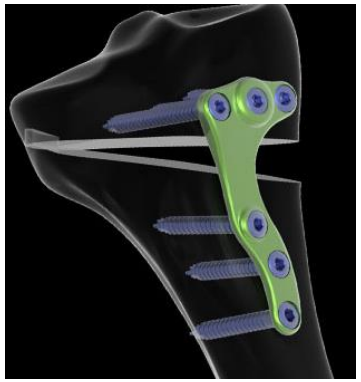
Discussion

- Moon et al found that the mean hinge axis was 4.92° ± 3.86° posterolaterally compared with the AP axis and that the hinge axis was a significant factor in changing the PTS.
- Park et al have defined the “hinge position” relative to anatomic landmarks in the coronal and sagittal planes, but this fails to take into account the rotation of the hinge position in the axial view



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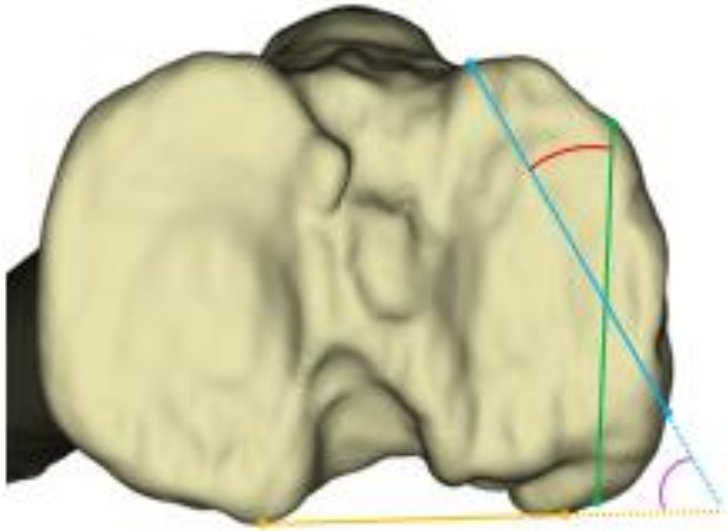
Conclusions

- The mean hinge axis position for slope-neutral osteotomy was 102.6 ± 8.3 relative to the PCA. For smaller corrections in the coronal plane, more extreme hinge axis positions were necessary to achieve higher magnitudes of PTS reduction.



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