

Femoral Component Rotation in Robotic-Assisted Kinematically Aligned Total Knee Arthroplasty

Keleb Mehari¹, Zachary Morrissey², Rishi Balkissoon, MD, MPH^{1,2}, Christopher Drinkwater, MD²

Howard University College of Medicine¹, Nth Dimensions¹, University of Rochester Medical Center²

Introduction

- Femoral component rotation is a crucial step in total knee arthroplasty (TKA) to gain a balanced flexion gap and proper patellar tracking.¹
- There remains controversy on what the most optimal technique to achieve proper femoral component rotation.⁵
- Kinematically aligned (KA) TKA has been adapted to restore the natural joint line.⁶
- Patient measurements vary due to interindividual differences in knee anatomy.
- Robotic-Assisted TKA (RATKA) has been adapted with the potential to improve surgical precision during TKA.⁷
- Aim:** Determine the range of femoral component rotation using KA RATKA that allows us to achieve proper patellar tracking and construct stability.

Methods

- Retrospective review of medical records examining 321 patients who received KA RATKA procedures.
- Patients aged between 30 and 89 with no prior major knee trauma.
- Timeline of surgeries and data collection: November 2021-May 2023.
- Surgeries performed by the senior author using the VELYSTM robotic solution and Depuy Attune Cruciate Retaining implant.

Results

- Femoral component rotation values were relative to the posterior condylar axis, with negative values being external rotation and positive values being internal rotation.
- Mean of -1.32 degrees.
- Standard deviation of 2.24, and a variance of 5.00.
- The range of femoral rotation was from -8 degrees (external rotation) to 4 degrees (internal rotation).
- 2 patients required intraoperative lateral release for mild patellar maltracking with measurements of 2 and 2.5 degrees internal rotation.

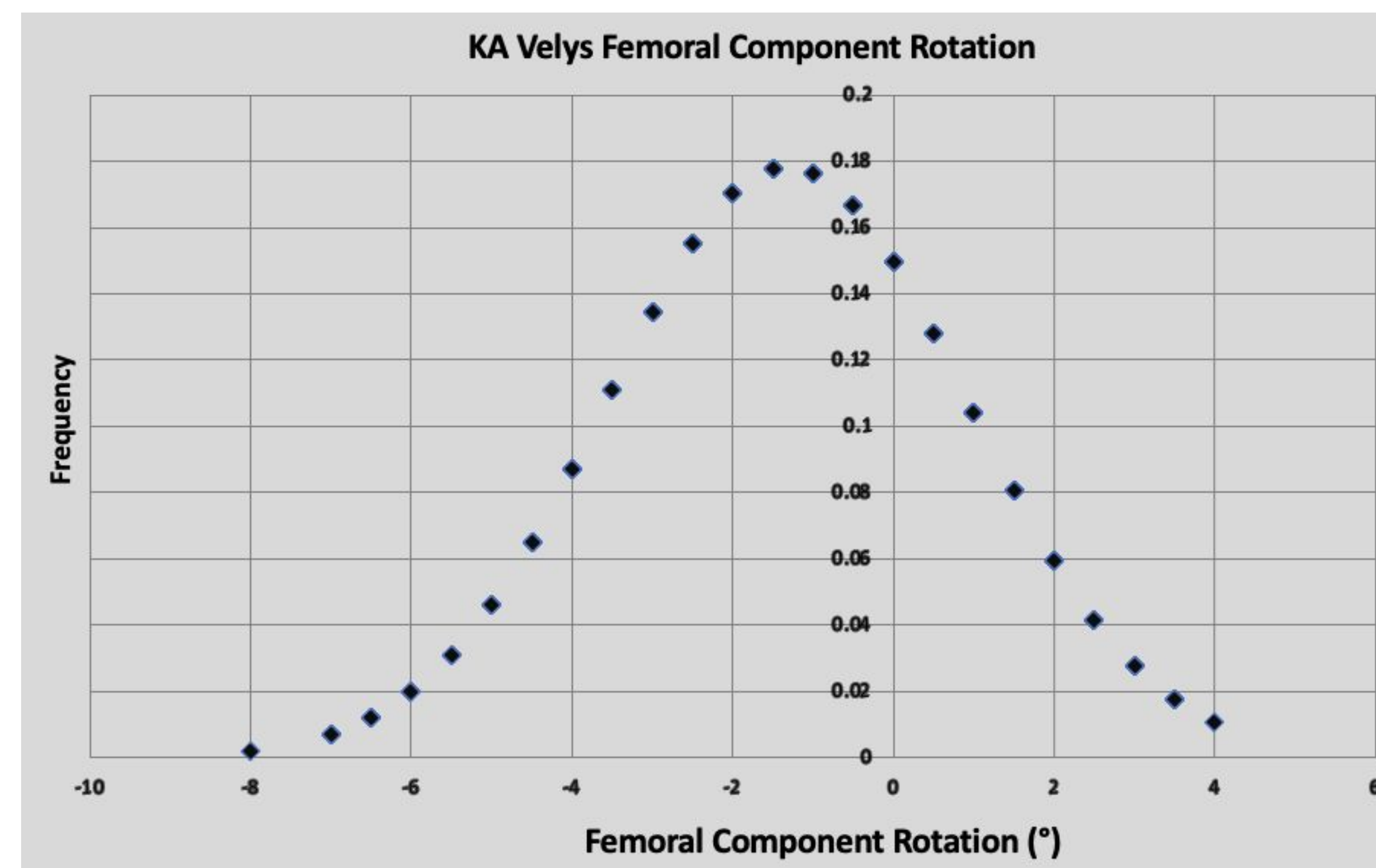


Figure 1: Normal Distribution of 321 patients' femoral component rotation.

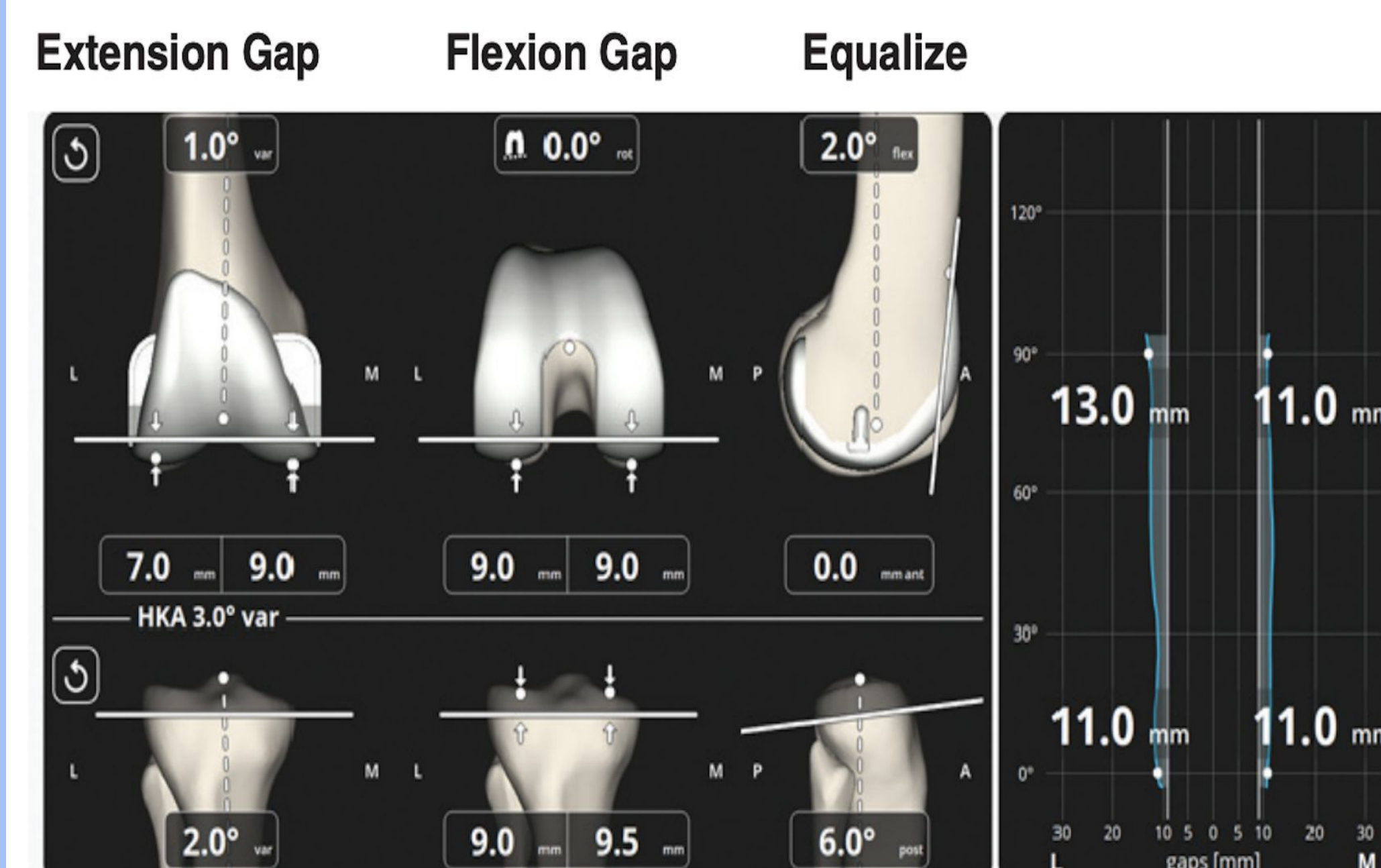


Figure 2: Example of Velys patient specific TKA balance graph and resections.

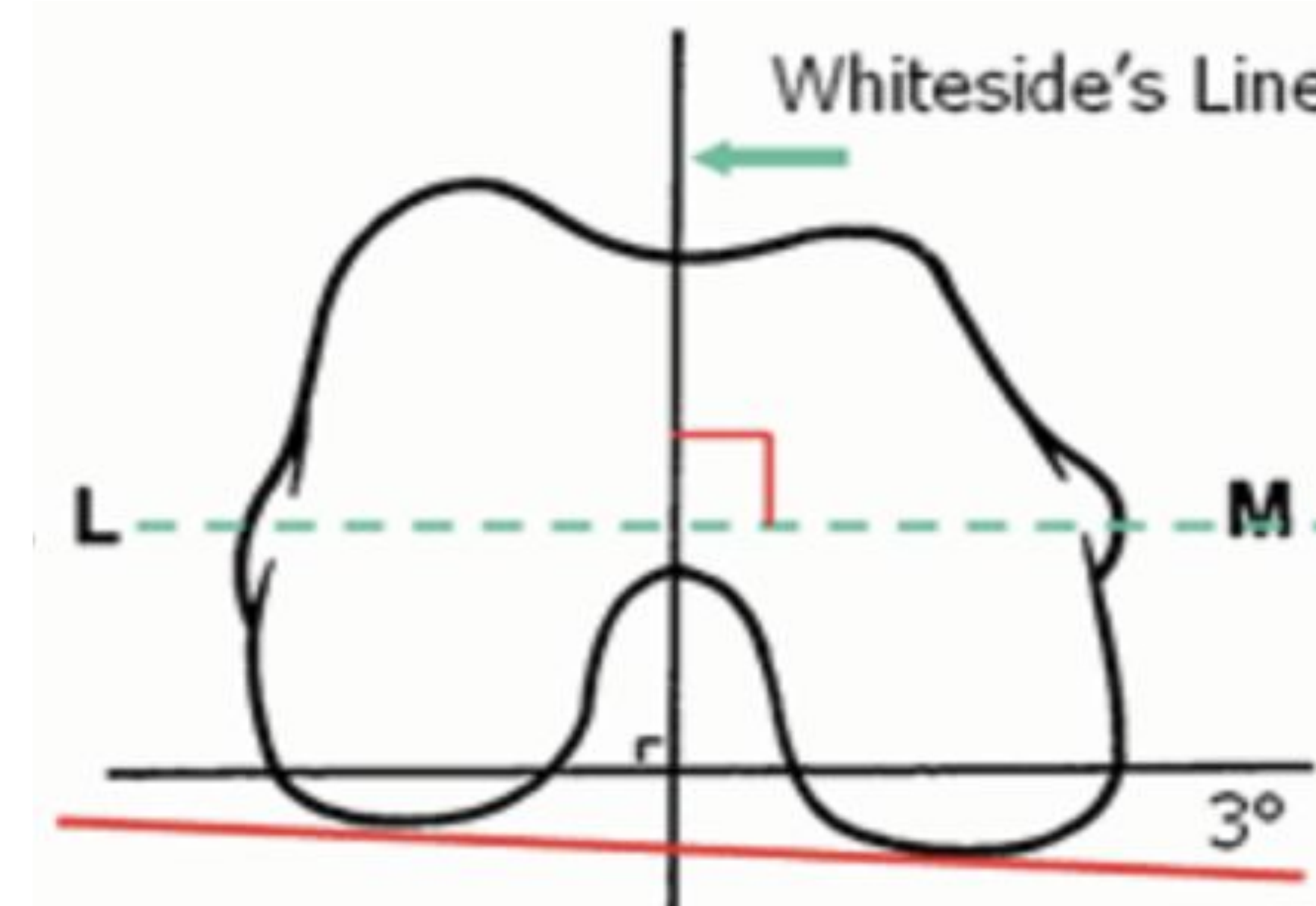


Figure 3: Reference axes for femoral component rotation. Green dashed line: transepicondylar axis. Red solid line: posterior condylar axis.

Conclusions

- KA RATKA demonstrated a flexible range of optimal femoral component rotation measurements in 321 patients.
- Caution should be exercised with excessive internal rotation possibly leading to lateral release.
- Study shows that femoral component rotation should be individualized.
- The result of future studies of RA-TKA can further support the philosophy of tailored femoral component rotation.

References

- Toni Lange, Jochen Schmitt, Christian Kopkow, Elisabeth Rataj, Klaus-Peter Günther, Jörg Lützner, What Do Patients Expect From Total Knee Arthroplasty? A Delphi Consensus Study on Patient Treatment Goals, The Journal of Arthroplasty, Volume 32, Issue 7, 2017, Pages 2093-2099.e1, ISSN 0883-5403, <https://doi.org/10.1016/j.arth.2017.01.053>, (<https://www.sciencedirect.com/science/article/pii/S0883540317300852>)
- Barrack, Robert L. MD; Schrader, Tim MD; Bertol, Alexander J. MD; Wolfe, Michael W. MD; Myers, Leann PhD. Component Rotation and Anterior Knee Pain After Total Knee Arthroplasty. Clinical Orthopaedics and Related Research 392(p 46-55, November 2001.
- Berger, R. A. MD; Crossett, L. S. MD; Jacobs, J. J. MD; Rubash, H. E. MD. Malrotation Causing Patellofemoral Complications After Total Knee Arthroplasty. Clinical Orthopaedics and Related Research 356(p 144-153, November 1998.
- Richard S. Laskin, Flexion space configuration in total knee arthroplasty, The Journal of Arthroplasty, Volume 10, Issue 5, 1995, Pages 657-660, ISSN 0883-5403, [https://doi.org/10.1016/S0883-5403\(05\)80211-6](https://doi.org/10.1016/S0883-5403(05)80211-6).
- Siston, Robert A. MS; Patel, Jay J. MS; Goodman, Stuart B. MD, PhD; Delp, Scott L. PhD; Giori, Nicholas J. MD, PhD. The Variability of Femoral Rotational Alignment in Total Knee Arthroplasty. The Journal of Bone & Joint Surgery 87(10):p 2276-2280, October 2005.
- Howell S M, Roth J D, Hull M L. Kinematic Alignment in Total Knee Arthroplasty: Definition, History, Principle, Surgical Technique, and Results of an Alignment Option for TKA. Arthropeadia 2014;1:44-53.
- Asokan, A.K., Ibrahim, M.S., Kayani, B., Haddad, F.S. (2022) Overview of Robotics in Total Knee Arthroplasty. In: Sharma, M. (eds) Knee Arthroplasty. Springer, Singapore. https://doi.org/10.1007/978-981-16-8591-0_34

Acknowledgement

I would like to thank Dr. Balkissoon, MD, MPH, whose guidance and knowledge strengthened my interest in orthopaedic surgery. I would also like to thank Dr. Drinkwater for allowing me to be a part of this research and letting me shadow so many fascinating surgeries. Finally, I would like to thank Nth Dimensions for giving me the opportunity to chase my dream of becoming an orthopaedic surgeon.