

The Effect of Knee Rotation Angle on Patellofemoral Instability

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Disclosures

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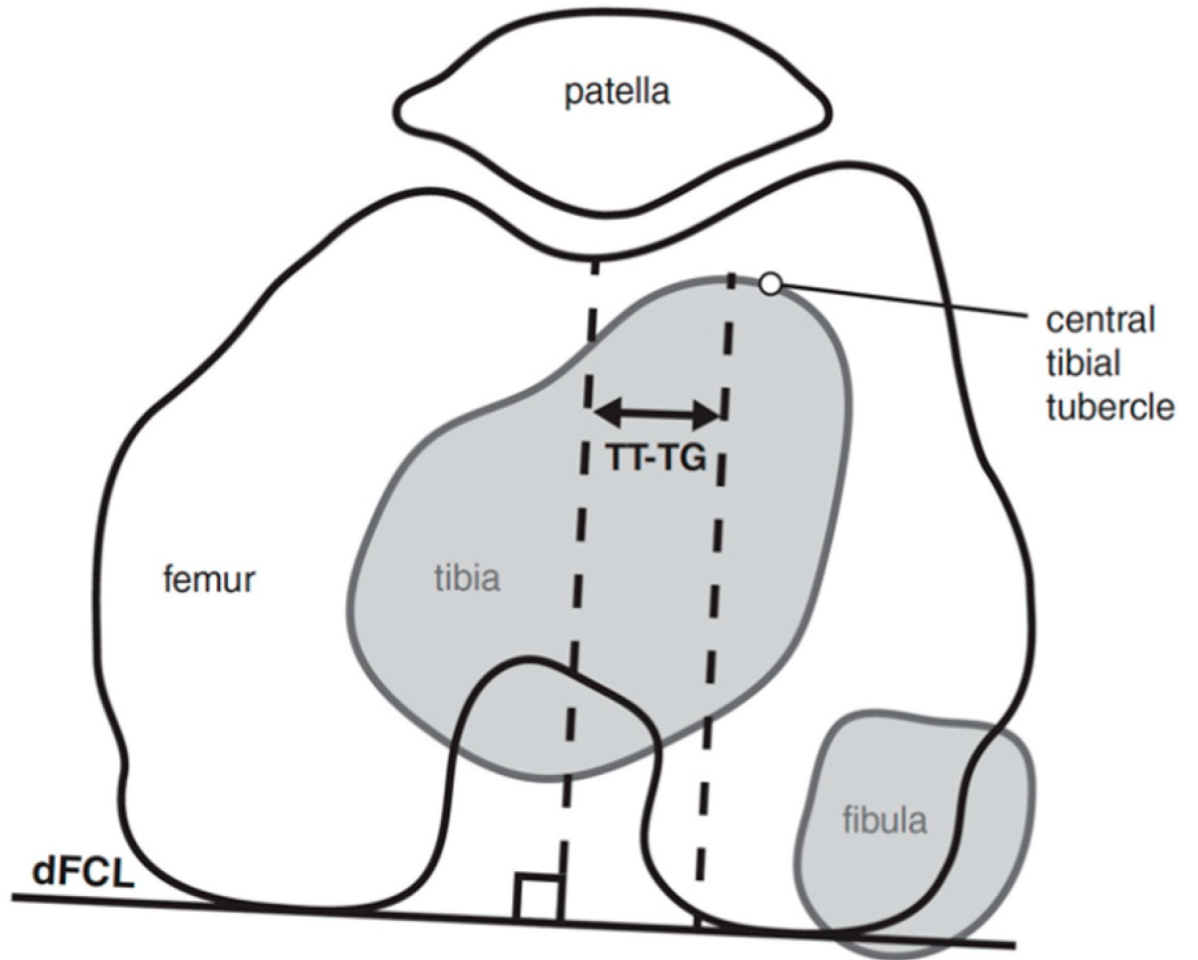
Patellofemoral Instability

- 3% of knee injuries
- 5.8 per 100,000 general population
- 29 per 100,000 in individuals 10-16 years old
- 33% of first-time dislocations will re-dislocate

Risk Factors
Patella Alta
Tibial Tubercle Trochlear Groove Distance $\geq 20\text{mm}$
Coronal or Rotational Malalignment
Trochlear Dysplasia
Female Sex
Age 10-16

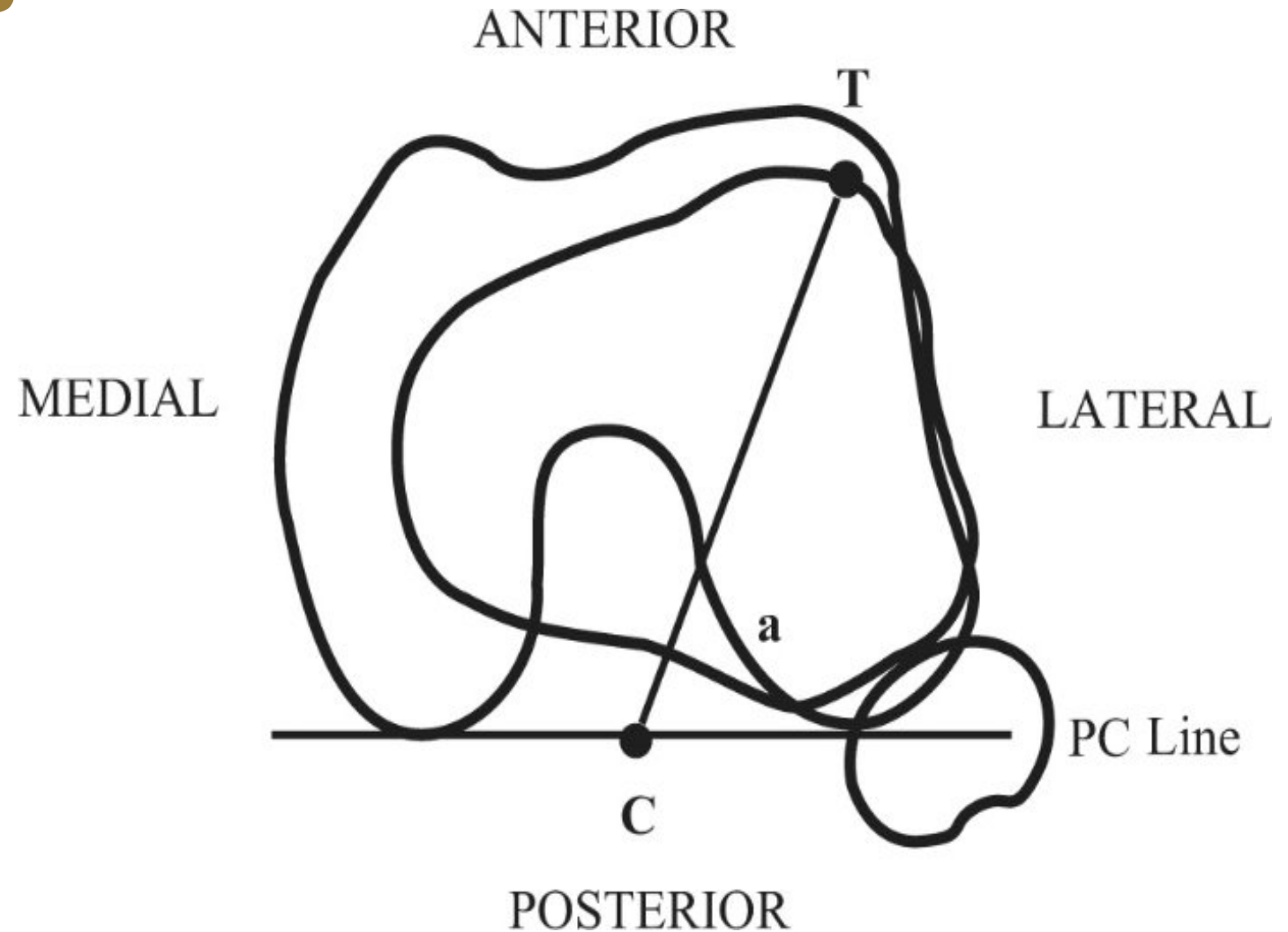
Tibial Tubercle Trochlear Groove Distance

- Distance between deepest point of trochlear groove and most anterior central point of tibial tubercle
- Function of tibial tubercle position and knee rotation angle



Knee Rotation Angle

Angle between the posterior femoral condylar line at the widest AP diameter and posterior tibial condylar line at the level of the posterior cruciate ligament insertion



Aim of Study

Is there a threshold value of knee rotation angle which acts as an independent risk factor for patellar instability?

Methods

Retrospective review of patients who underwent isolated medial patellofemoral ligament reconstruction (MPFLr) and comparison group who underwent isolated partial meniscectomy (IPM) from 2018-2023

Parameters of interest measured on MRI

- **Tibial Tubercle Trochlear Groove Distance (TT-TG)**
- **Knee Rotation Angle (KRA)**
- **Knee Flexion Angle (KFA)**

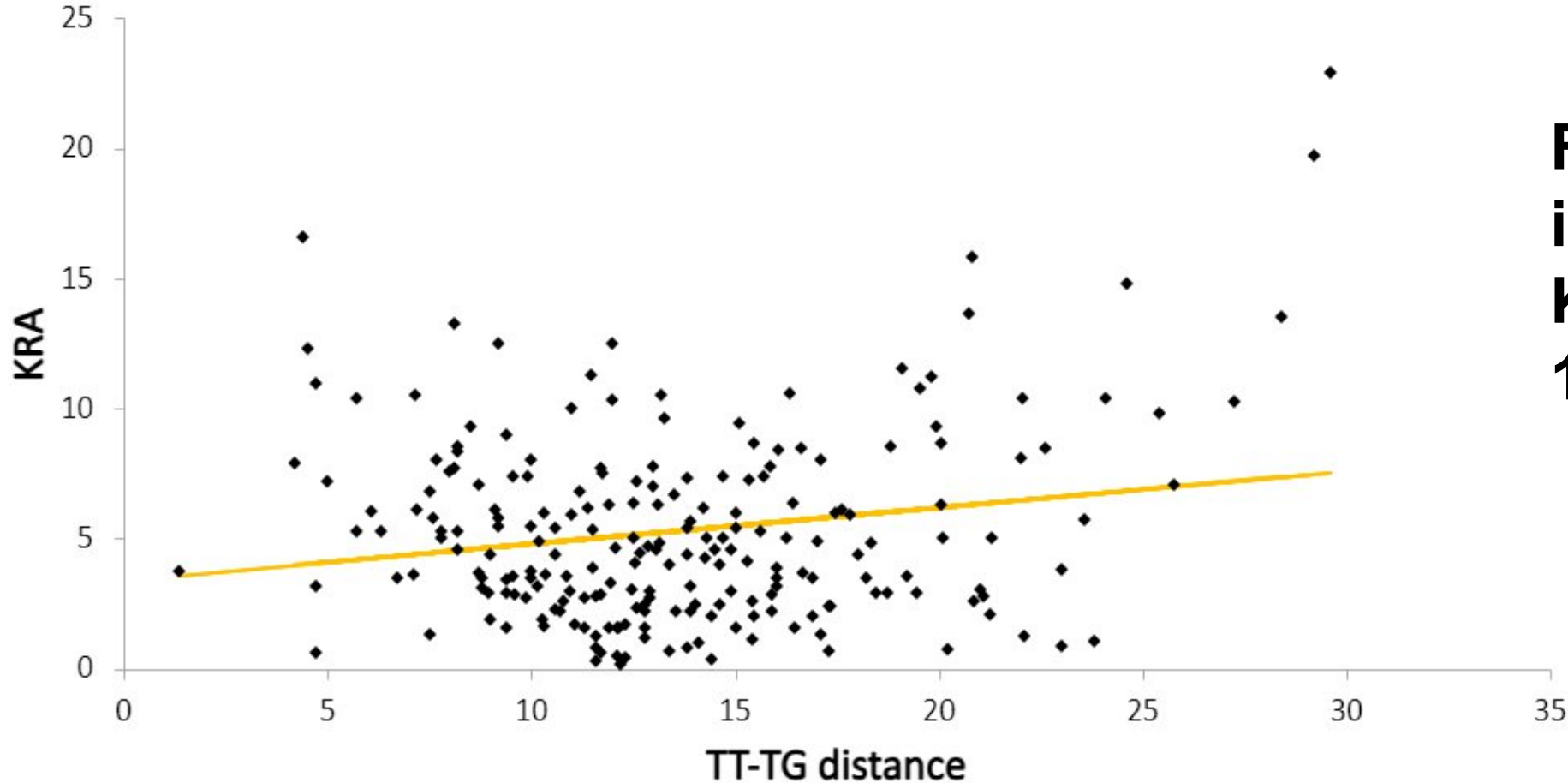
Results

	MPFLr	IPM	p value
Number of Patients	122	96	
Age (years)	21.1 ± 9.8	38 ±17.6	
Female (%)	73 (59.8)	47 (49.0)	
TT-TG (mm)	15.3 ± 5.4	11.4 ± 3.5	p<0.001**
KRA (degrees)	5.9 ± 4.1	4.7 ± 2.8	p=0.018*
KFA (degrees)	7.0 ± 4.9	7.2 ± 5.2	p=0.39



Linear Regression Analysis

TT-TG and KRA Linear Regression



For every 5mm increase in TT-TG, KRA increased by 1.0° (p=0.034*)



Logistic Regression Analysis

Knee measurements significantly associated with MPFLr	p value
KRA	p=0.034
TT-TG	p<0.001

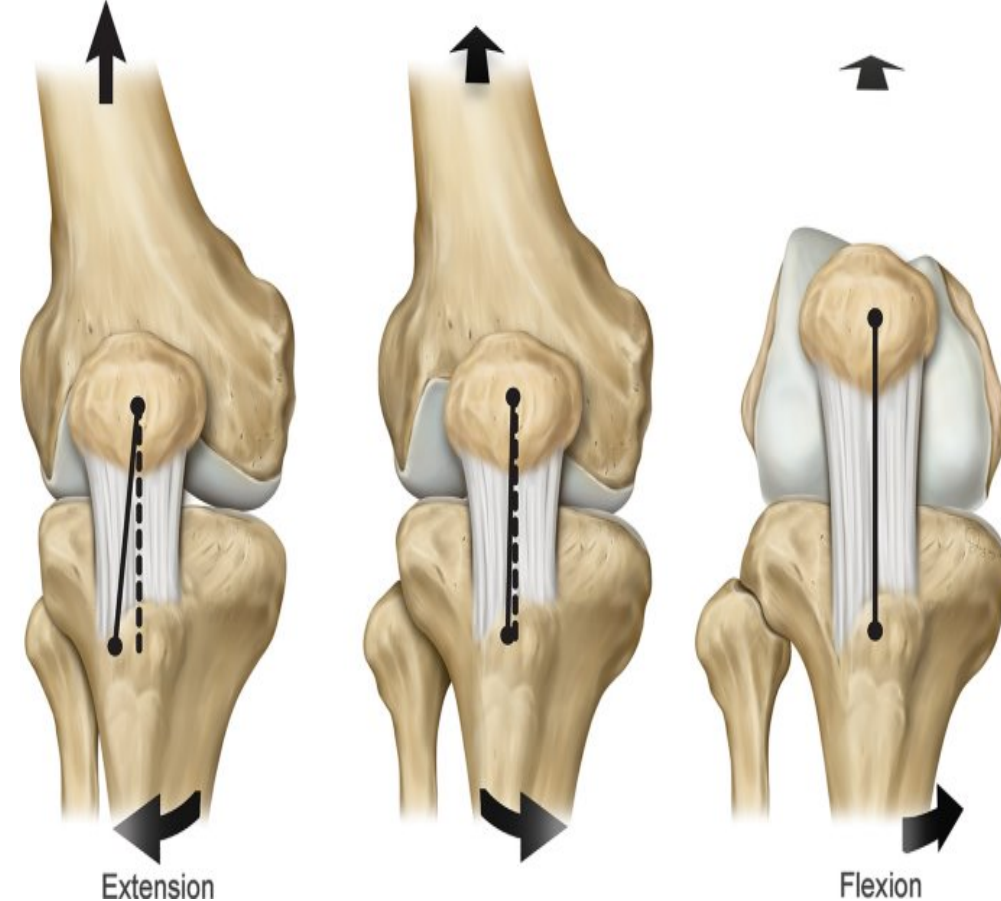
- KRA > 8.07° had a specificity of 76% in relation to MPFLr
- TT-TG > 15mm had a specificity of 85% in relation to MPFLr

Patient demographics significantly associated with MPFLr	p value
Female Sex	p=0.009
Age	p<0.001

- Every one year decrease in patient age, 0.1x more likely to undergo MPFLr

Discussion

- What is the role of KRA in patellar instability?
 - $KRA \geq 17.7^\circ$ showed a 55-fold increased probability of patellar instability
- What is the KFA and KRA relationship?
 - Tibia externally rotates around 15° during the final 20° of knee flexion
- TT-TG distance may have a lower threshold limit ($>15\text{mm}$)



Conclusions

- **KRA is associated with patellar instability even when controlling for TT-TG distance**
- **KRA > 8.07° may be an independent risk factor for patellar instability requiring surgical management**
- **KRA does not appear to be influenced by KFA**
- **Further research is needed to determine the role of KRA in the setting of patellar instability and surgical decision making**

References

- Fithian DC, Paxton EW, Stone ML, Silva P, Davis DK, Elias DA, White LM. Epidemiology and natural history of acute patellar dislocation. *Am J Sports Med.* 2004 Jul-Aug;32(5):1114-21. doi: 10.1177/0363546503260788. Epub 2004 May 18. PMID: 15262631.
- Huntington LS, Webster KE, Devitt BM, Scanlon JP, Feller JA. Factors Associated With an Increased Risk of Recurrence After a First-Time Patellar Dislocation: A Systematic Review and Meta-analysis. *Am J Sports Med.* 2020 Aug;48(10):2552-2562. doi: 10.1177/0363546519888467. Epub 2019 Dec 11. PMID: 31825650.
- Palmer RC, Podeszwa DA, Wilson PL, Ellis HB. Coronal and Transverse Malalignment in Pediatric Patellofemoral Instability. *J Clin Med.* 2021 Jul 8;10(14):3035. doi: 10.3390/jcm10143035. PMID: 34300200; PMCID: PMC8307206.
- Steensen RN, Bentley JC, Trinh TQ, Backes JR, Wiltfong RE. The Prevalence and Combined Prevalences of Anatomic Factors Associated With Recurrent Patellar Dislocation: A Magnetic Resonance Imaging Study. *The American Journal of Sports Medicine.* 2015;43(4):921-927. doi:10.1177/0363546514563904
- Dejour H, Walch G, Nove-Josserand L, Guier C. Factors of patellar instability: an anatomic radiographic study. *Knee Surg Sports Traumatol Arthrosc.* 1994;2(1):19-26. doi: 10.1007/BF01552649. PMID: 7584171.
- Muneta T, Yamamoto H, Ishibashi T, Asahina S, Furuya K. Computerized tomographic analysis of tibial tubercle position in the painful female patellofemoral joint. *Am J Sports Med.* 1994 Jan-Feb;22(1):67-71. doi: 10.1177/036354659402200112. PMID: 8129113.
- Ma LF, Wang F, Chen BC, Wang CH, Zhou JW, Wang HY. Medial retinaculum plasty versus medial patellofemoral ligament reconstruction for recurrent patellar instability in adults: a randomized controlled trial. *Arthroscopy.* 2013 May;29(5):891-7. doi: 10.1016/j.arthro.2013.01.030. Epub 2013 Apr 6. PMID: 23566568.
- Jud L, Hartmann M, Vlachopoulos L, Zimmermann SM, Ackermann J, Fucentese SF. Increased tibial tuberosity torsion has the greatest predictive value in patients with patellofemoral instability compared to other commonly assessed parameters. *Knee Surg Sports Traumatol Arthrosc.* 2024 May;32(5):1179-1186. doi: 10.1002/ksa.12151. Epub 2024 Mar 19. PMID: 38504510.
- Zarins B, Rowe CR, Harris BA, Watkins MP. Rotational motion of the knee. *Am J Sports Med.* 1983 May-Jun;11(3):152-6. doi: 10.1177/036354658301100308. PMID: 6869656.
- Seo, SS., Lee, GH., Seo, KJ. (2021). Anatomy and Biomechanics. In: Seo, SS. (eds) A Strategic Approach to Knee Arthritis Treatment. Springer, Singapore. https://doi.org/10.1007/978-981-16-4217-3_1

