Comparing Posterior Tibial Slope Measurements By Magnetic Resonance Imaging And Radiography: Lack Of Correlation In ACL-Reconstructed Patients With Increased Slope

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Background

Imaging modality is the primary determinant of resulting slope angle

Garra, Alaia, AJSM, 2023

Large differences in different studies reporting slope values in different cohorts

Duerr et al, Arthroscopy, 2023

Large differences in medial versus lateral slope on MRI measurements in different studies

Rahnemai-Azar, Musahl, KSSTA, 2017
Kolbe, KSSTA, 2019

Slope values between ACL injured and ACL intact is close with different outlier profiles

Weiler et al, AJSM, 2023

Background

Reasons for these differences:

Measurement technique

MRI → lower slope values

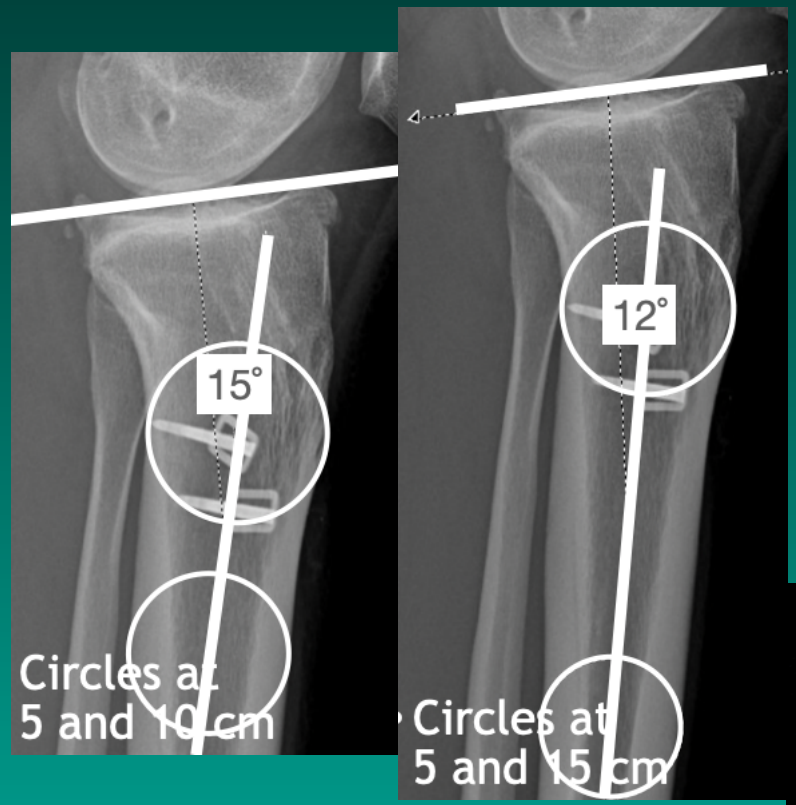
Shorter radiographs → lower slope values

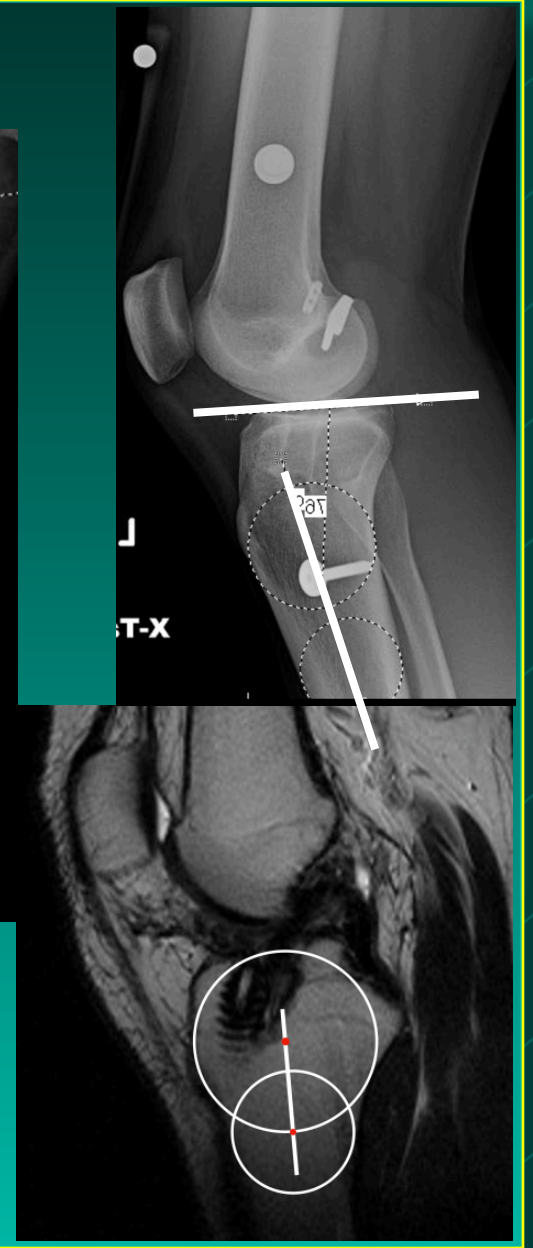
Tibial axis determination

Different anatomic landmarks in axis determination

Tibial slope determination

Medial slope vs global slope





Faschingbauer et al., KSSTA, 2014
Weiler et al., AJSM, 2023
Abs and Ollivier, OJSM, 2023

Aims

- Define the slope measurements, i.e. slope on radiography, and medial and lateral slope on MRI, in two different cohorts:
  - (1) multiple revision ACL cohort
  - (2) primary successful ACL cohort
- Compare slope parameters between these cohorts
- Compare slope parameters within the groups with a slope cut-off value
- Analyse the correlations between radiography and MRI measurements within the cohorts for different slope cut-off values

Methods

Multiple revision ACL cohort

MRIs weren't accessible in 5 of the patients

The remaining 78 patients were included:

Confirmed operation notes,

Available MRI,

proper lateral knee x-rays, i.e. ≤5 mm posterior or distal femoral condylar overlap and shorter than 10 cm proximal tibial lenght

Primary successful ACLR cohort:

78 consecutive unilateral ACLR patients with

clinical follow-up of at least 2 years

age >14 years at the time of surgery

w/o history of ACLR graft tear

starting from two different time points to correspond to the multiple revision cohort obtained over the last 10 years:

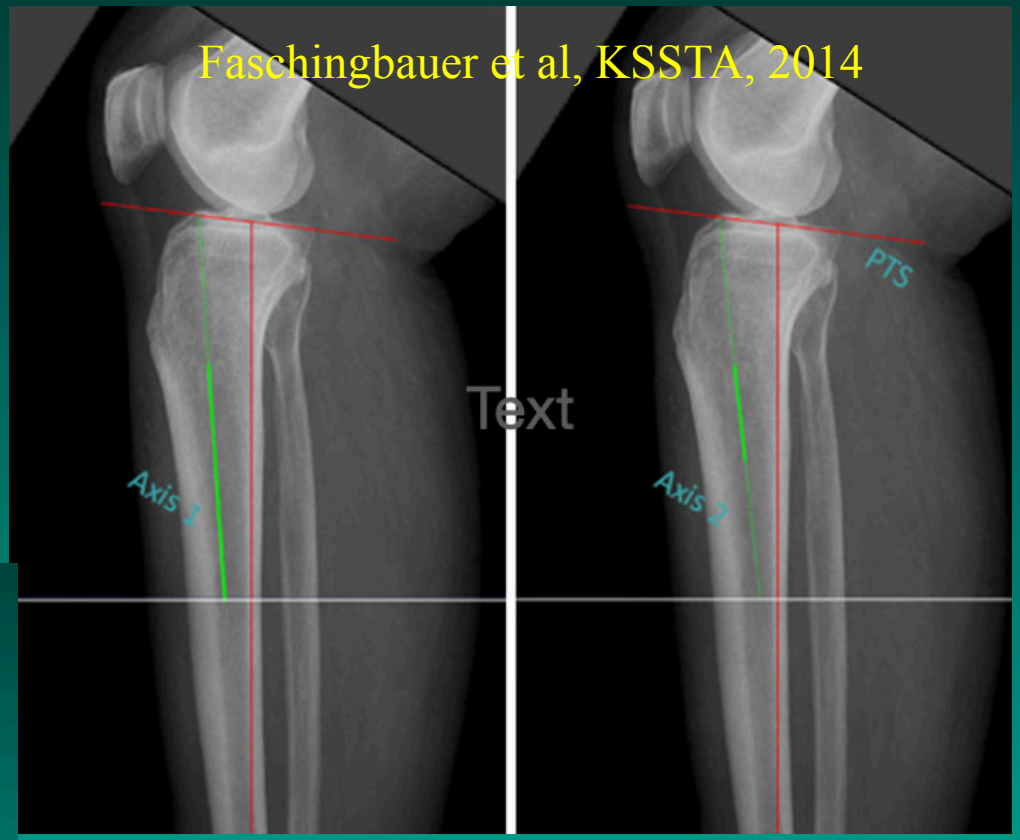
2013 and forward, and 2018 and forward

Methods

- Included: a total of 156 patients
- Medial PTS was measured using both radiographs and MRI.
- Radiographic PTS was measured as the angle between the medial tibial plateau and a line tangent to the anatomic axis of the tibia.
- PTS on MRI was defined as the angle between a line orthogonal to the medial plateau and the proximal anatomic axis on the central sagittal slice
- Patients were categorized into a high-risk group for graft tear (≥13˚) and a normal PTS group (<13˚) based on literature-defined cut-offs
- Associations between MRI and radiographic measurements were analyzed using Pearson correlation for each group.
- The reliability of PTS measurements was assessed by two blinded raters.

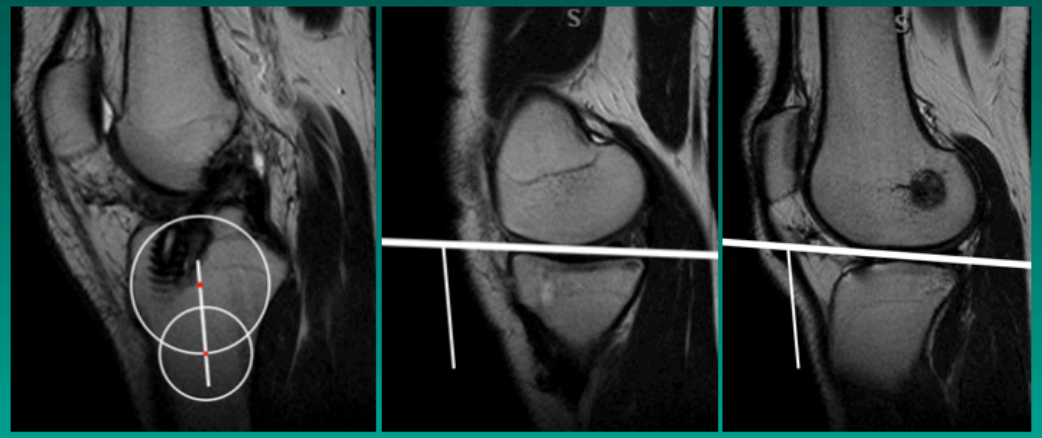
Methods

- Slope on Radiograph:
- 15 cm vs 10 cm: difference of 1.2˚ in average slope values



- MRI measurement:

Hudek et al, CORR, 2009



Results

- The mean medial PTS was 11.9±3.4˚ in radiographic measurements and 3.4±3.5˚ in MRI measurements.
- In patients with a PTS of ≥13˚ on radiographic measurement, the difference in medial PTS between radiography and MRI was significantly larger than in patients with a PTS of <13˚ (10.2±3.8 vs 7.3±3, p<.001)

	Lateral slope	**Slope difference**
Slope ≥13˚ (n=65, 42%)	6.8±3.5	1.4±3.3
Slope <13˚ (n=91, 58%)	5.6±3.6	2.9±3.1
P-value	**p=0.01***	**p=0.01****
***Independent t-test, **Mann Whitney U**		

Results

- A moderate and statistically significant correlation was found between radiographic and medial MRI PTS in patients with a PTS of <13˚ (r=0.39, p<.001). However, no correlation was observed between MRI and radiographic measurements in patients with a PTS of ≥13˚ (r=0.11, p=.35).
- Interobserver reliability was excellent (Cronbach's α =0.902 and 0.851), as was intraobserver reliability for both radiographic and MRI measurements (Cronbach α=0.924 and 0.852), respectively.

Pearson correlation coefficient, p value	**Correlation with MRI medial slope**	**Correlation with MRI lateral slope**
Slope on radiograph	**r=0.44, p<.001**	**r=0.21, p=.009**
Slope in revision ACL cohort ≥13˚	r=0.12, p=.35	r=0, p=.99
Slope in revision ACL cohort <13˚	**r=0.39, p<.001**	r=0.20, p=.06

Conclusion

- Deformity in sagittal malalignment:
  1. Patients with a higher slope angle (≥13˚) exhibit a more distal deformity location
  2. MRI measurement of lateral slope has no correlation with lateral radiography measurements in patient with ≥13˚ of slope and should not be referred to in surgery decision making

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Thank you

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