The Influence of Lower Limb Alignment on (Medial) Collateral Ligament Strain

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Disclosures

- Deputy Editor-in-Chief KSSTA

19 y.o., subjective instability, status post KD Schenck III lateral

UKM Discussion

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KNEE

Posterolateral corner of the knee: an expert consensus statement on diagnosis, classification, treatment, and rehabilitation

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In chronic cases, varus malalignment should be corrected with a valgus producing high tibial osteotomy prior to, or at the time of PLC reconstruction

Purpose and Hypotheses

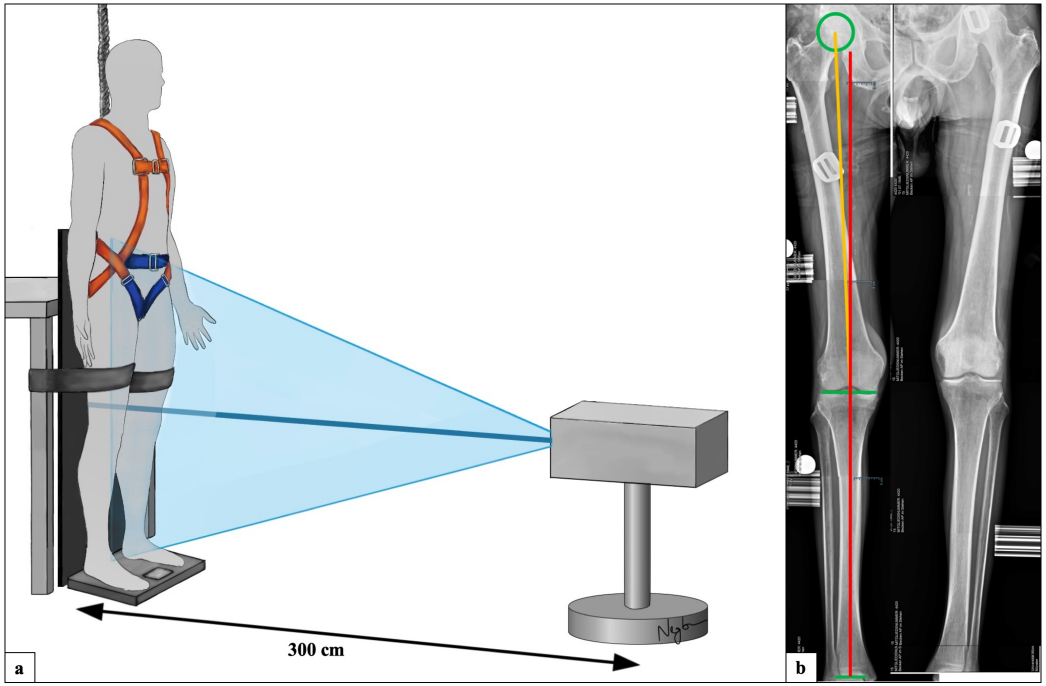
- To analyze the influence of coronal lower limb alignment on collateral ligament strain of the native knee

- It was hypothesized, that
  - 1) the strain within the native ligaments is linearly associated with lower limb alignment
  - 2) a lower limb malalignment of more than 5° is associated with strain values above 4%

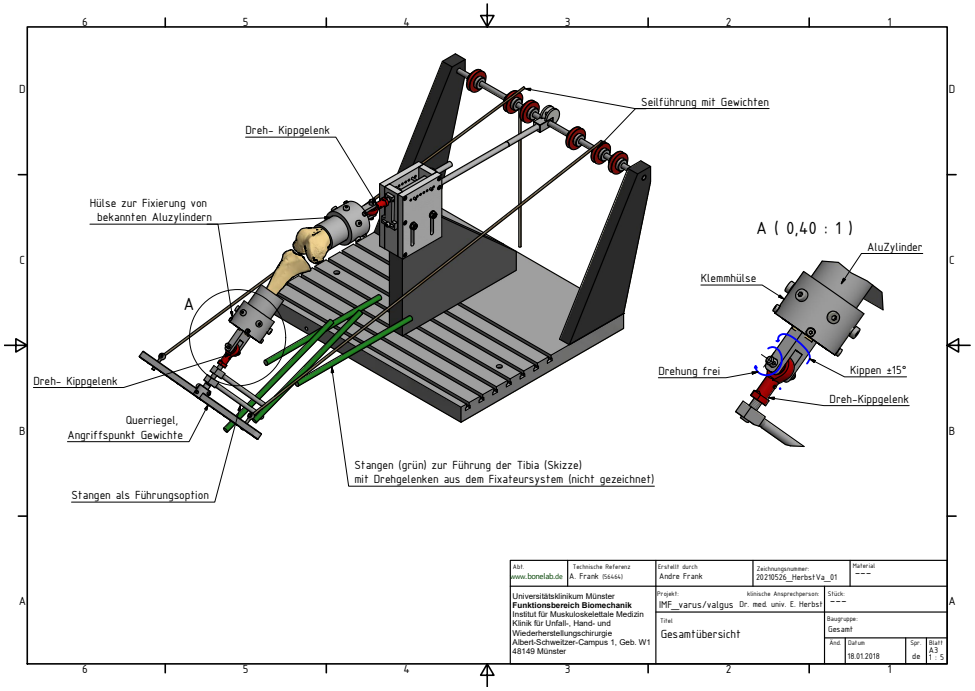
Material and Methods

- 12 fresh-frozen human cadaveric knees (79.7 ± 5.7)

- Long leg “standing radiographs“ to analyze the lower limb alignment
  - Mobilized with a harness



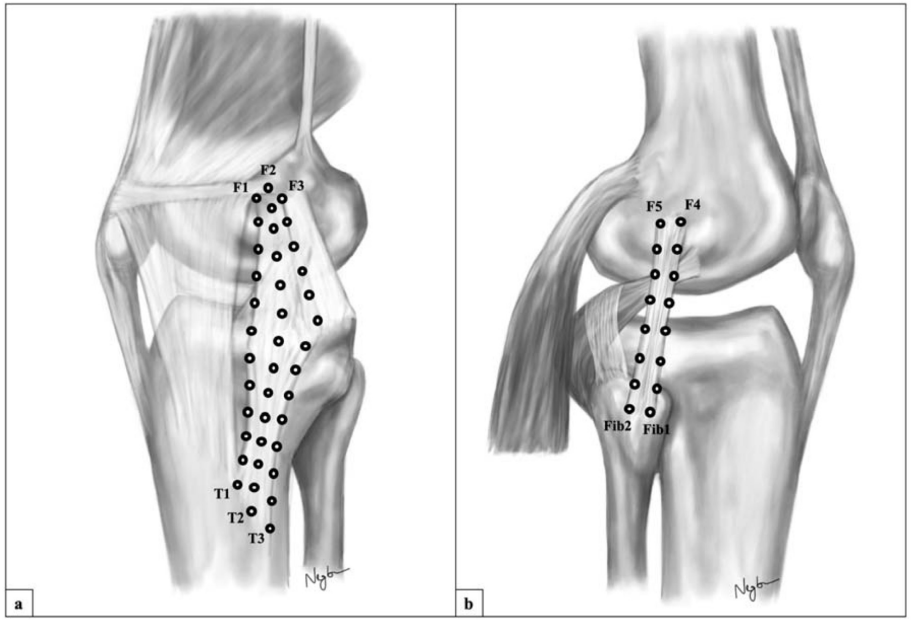
Material and Methods

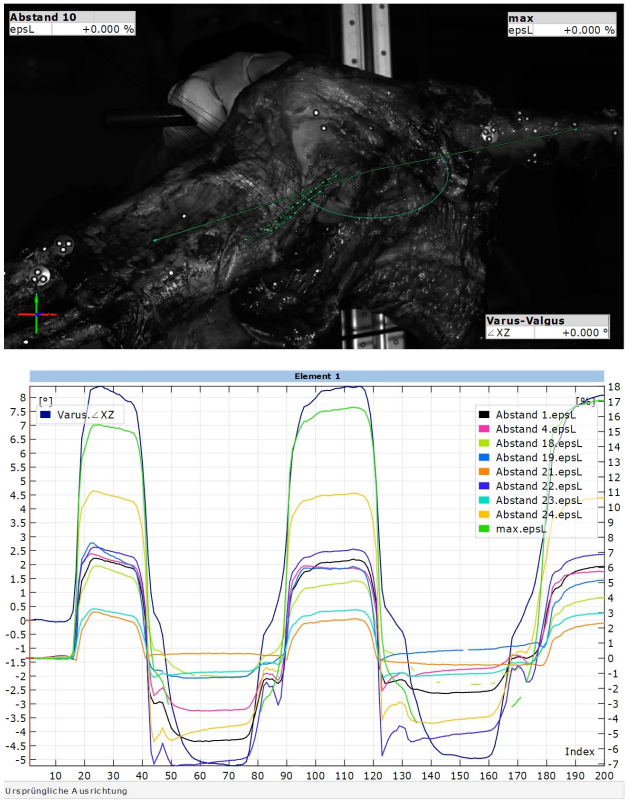


- Knees tested with axial loading of 200N and 400N
- Varus/valgus stress (manual maximum) at 0°, 30°, 60°, 90°
- Native knees

Material and Methods

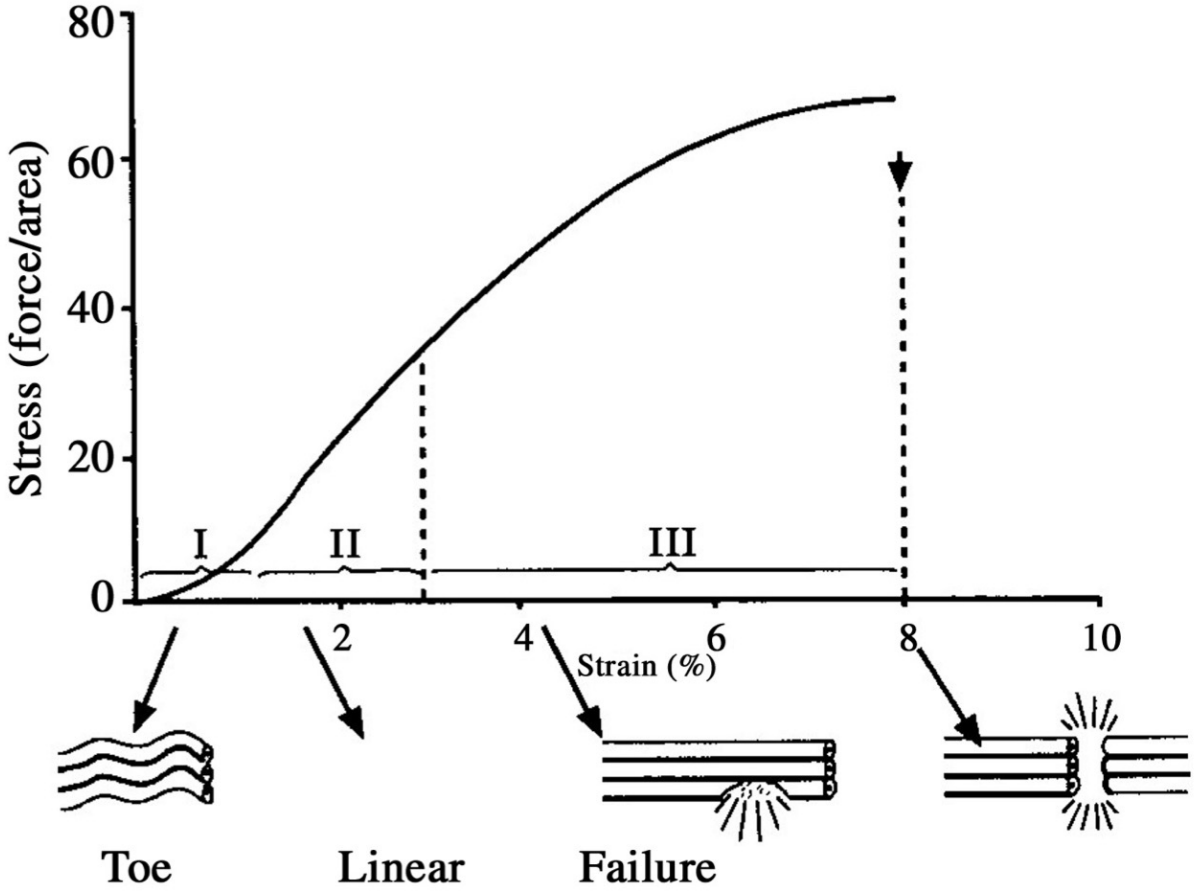
- Optical tracking using the ARAMIS 12M system (gom; Braunschweig)
  - Resolution 4096x3000 pixel
  - Measurement accuracy < 0.06mm





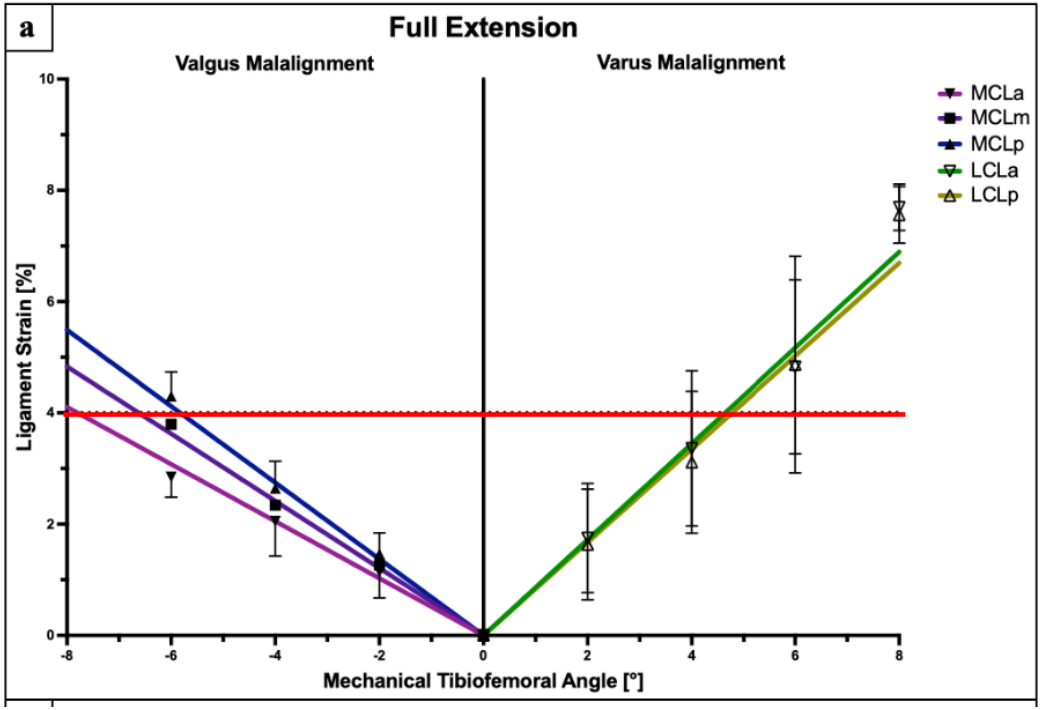
Janeliukstis, Chen, Composite Structures, 2021

Ligament strain and failure

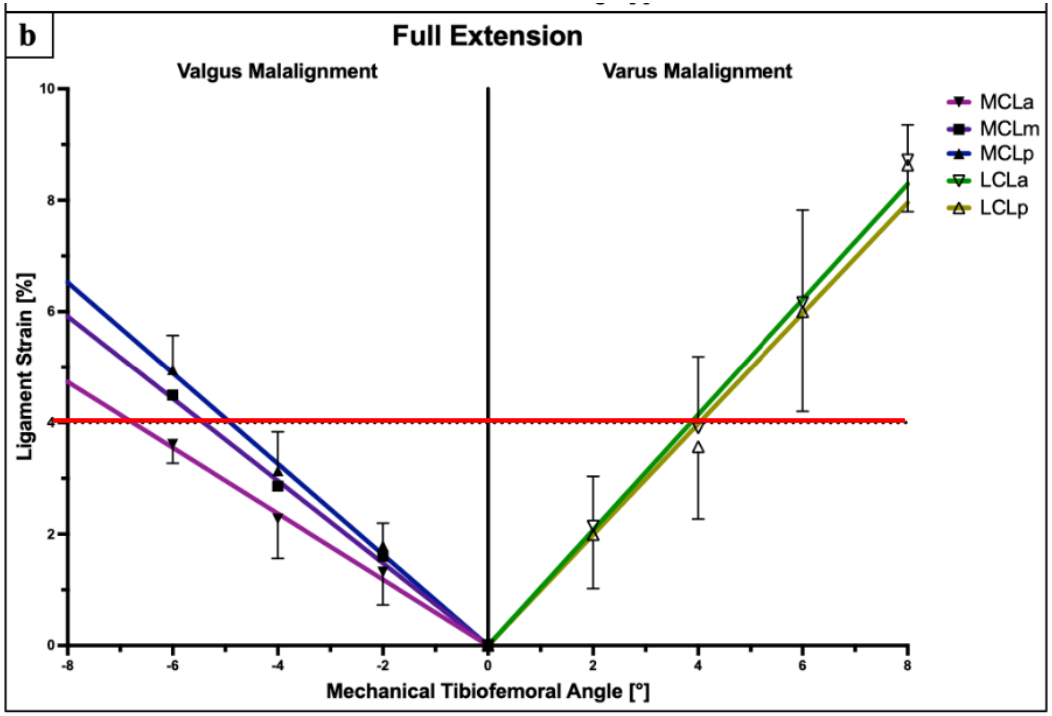


Sharma, Maffulli, JBJS, 2005

Results – full extension

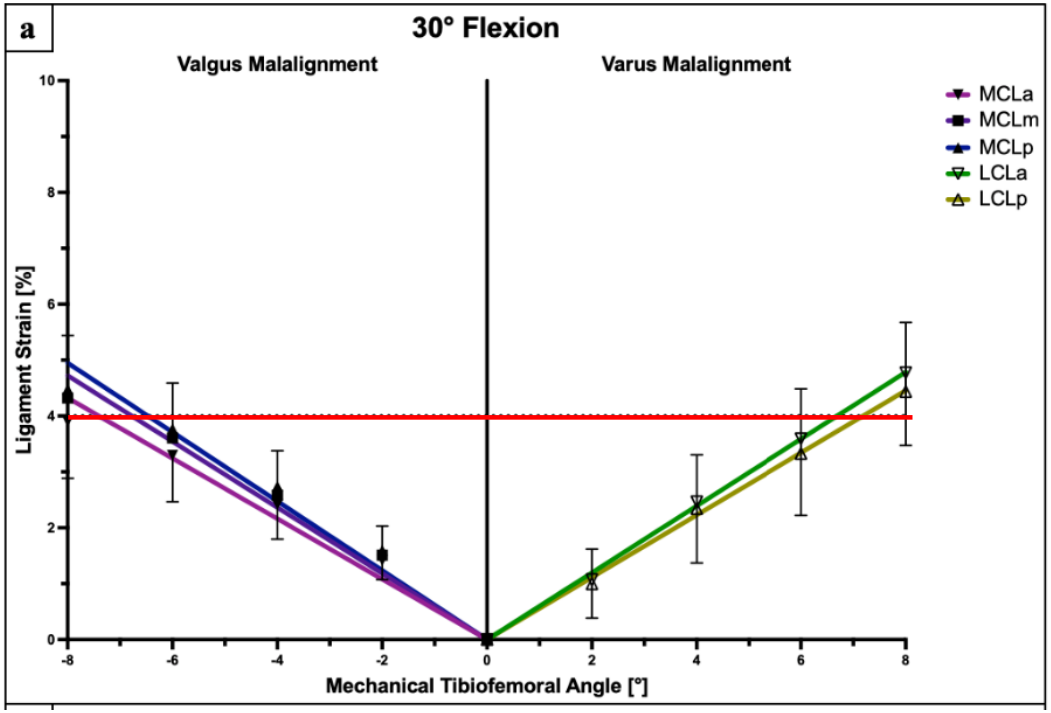


200 N axial load

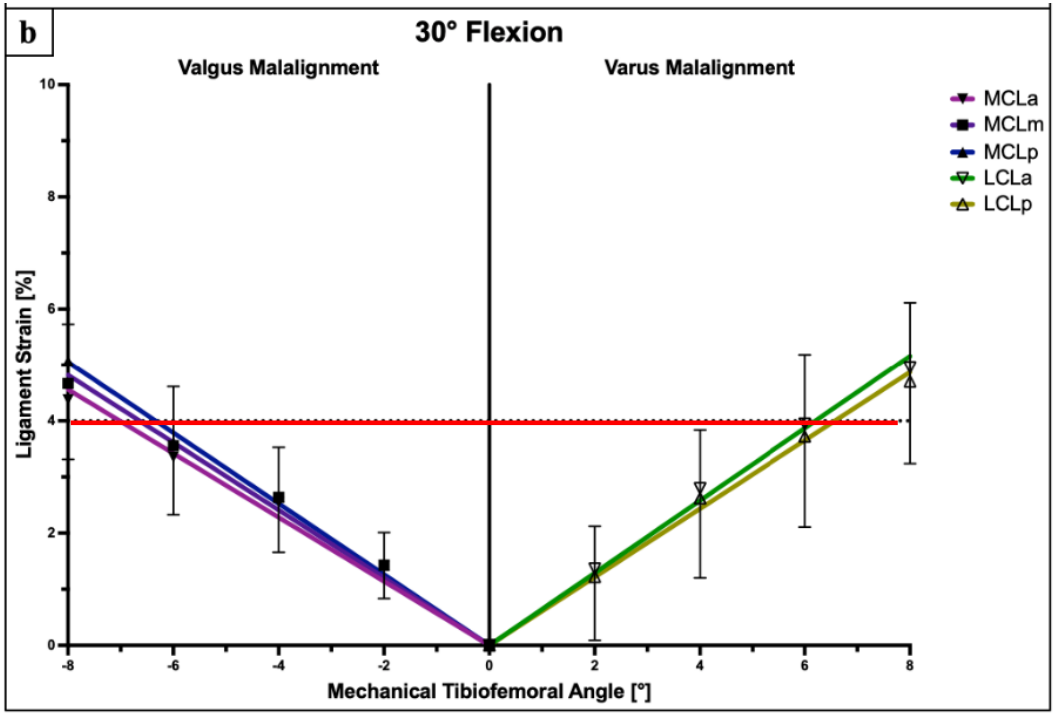


400 N axial load

Results – 30° flexion



200 N axial load



400 N axial load

Limitations

- Time zero biomechanical study
- Age of the specimen (79.7 y.o.)
- Axial loading only to maximally 400N (40kg)
- Loss of viscoelasticity in cadaveric specimen during testing
- No clinical data

Coronal alignment

Author(s), Year	Purpose	Study Design	Follow-up	Main Results	Level of Evidence
Noyes et al, 2006[44]	To determine the factors responsible for failed PLC procedures	• Retrospective analysis of 30 consecutive knees with 57 failed PLC procedures (13 acute and 17 chronic knee injuries) • A comprehensive review of medical records, operative notes, radiographs, and MRI scans was conducted to determine factors that may have contributed to failure	17 mo	• Among all 57 failed PLC procedures, untreated varus malalignment was identified in 21 procedures (37%), or in 10 of 30 knees	4
Noyes and Barber-Westin, 2005[43]	To determine the factors contributing to failure after PCL reconstruction	• Retrospective analysis of 52 failed PCL surgeries • Medical records, operative notes, radiographs, and MRI scans were reviewed, and a comprehensive knee examination was conducted	42 mo	• Varus malalignment was identified in 16 procedures (31%) • Varus malalignment was considered the sole factor contributing to failure in 1 procedure and as 1 of multiple factors contributing to failure in 15 procedures	4

Tischer et al. OJSM, 2017

Conclusion

- Highest strain at full extension

- **> 4° of varus malalignment resulted in strain levels of more than 4% within the LCL**
- **> 5° of valgus malalignment resulted in strain levels of more than 4% within the MCL**
  - Chronic failure over time after reconstruction?

- In chronic instabilities and a lower limb malalignment of more than 4° (varus) and 5° (valgus), a realigning osteotomy should be considered

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Thank you!

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