Influence of Different Reconstruction States in ACL-deficient Knee with Associated Borderline Bankart Fracture: a Biomechanical Cadaveric Study

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NO DISCLOSURES

Introduction

- Tibial posterolateral impression fractures (PLTF) are common concomitant injuries (49,3 %) of an anterior cruciate ligament (ACL) rupture resulting in a loss of osseous support of the posterior horn of the lateral meniscus.

- Posterolateral Tibial Plateau Measurements in Control Patient Group vs. PLTF Group
  → Posteriorheight (mm) 4.06 ±0.9 vs. 7.00 ±2.2 →**<u>Difference of 3mm</u>**

- It is unknown if the additional treatment of the PLTF presenting a 3mm of tibial depression and 50% of support of the external meniscus posterior horn brings a benefit in the treatment of symptomatic ACL-deficient knees.

Bernholt et al., 2020, AJSM

Aim

- Biomechanical Study:

  - Is there a difference comparing different reconstruction state in a ACL-deficient knee with 3mm PLTF to the native state on kinematics?

  - Is ACL-Reconstruction + Lateral Extra-articular Tenodesis (LET) enough compared to ACL-Reconstruction (ACLR) + PLTF- Reconstruction

Materials & Methods

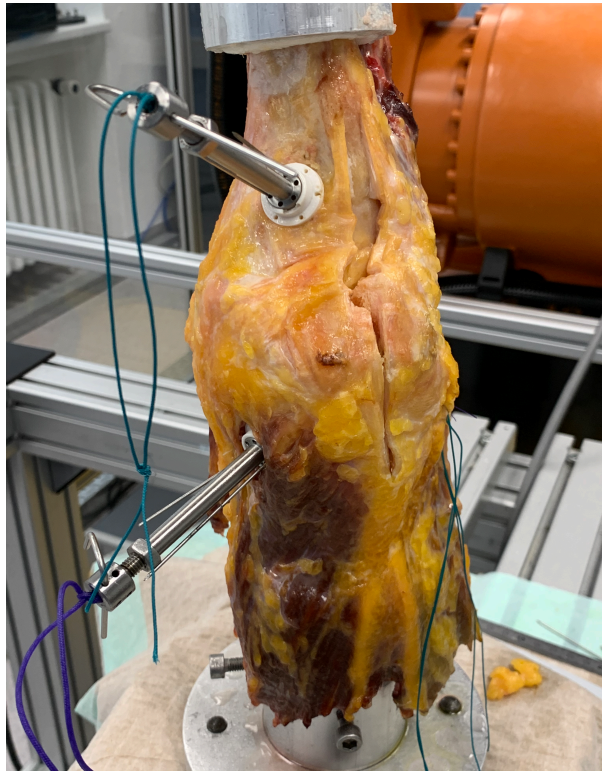
- 8 fresh frozen cadaveric knees + 1 test knee

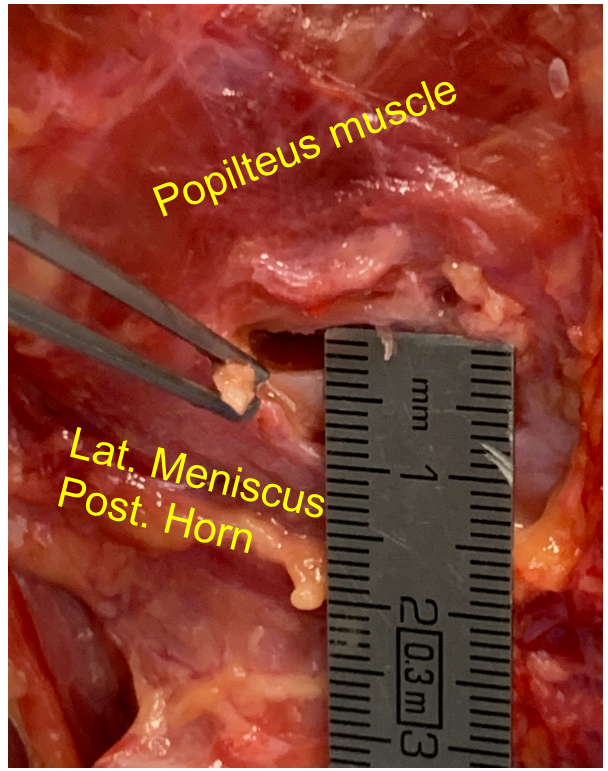
- A six degree of freedom robot (KR 125; KUKA Robotics, Augsburg, Germany) and force/moment sensor on robotic rig
- Software simVITRO (Cleveland Clinic BioRobotics Lab, Ohio, USA)

- Test-Protocol under constant 50N axial loading
  - Anteriore Translation (ATT) = 89N
    - ➢ 0°, 30°, 60°, 90° Flexion
  - Internal- (IR) and External-Rotation (ER) = 4Nm
    - ➢ 0°, 30°, 60°, 90° Flexion
  - Pivotshift-Test (ATT 89N, IR 4Nm, Valgus 8Nm):
    - ➢ in 0°, 15°, 30°, 45° Flexion

Materials & Methods

- Testing states:
  1. intact,
  2. ACL-deficient,
  3. ACL-deficient with PLTF
  4. ACLR with PLTF
  5. ACLR with LET and PLTF
  6. ACLR with reconstructed PLTF





PLTF: Grade III according to Smigielski

ACLR: Bone-Patellar-Bone Graft tensioned to 60N

LET: modified Lemaire tensioned to 20N

Menzdorf et al., ESTES, 2020
Amis et al., Knee Surg Sports Traumatol Arthrosc, 1998
Ackermann et al., Arthrosc Tech, 2019
Herbst et al., Oper Orthop Traumatol, 2019
Smigielski et al., ECR, 2018

Materials & Methods

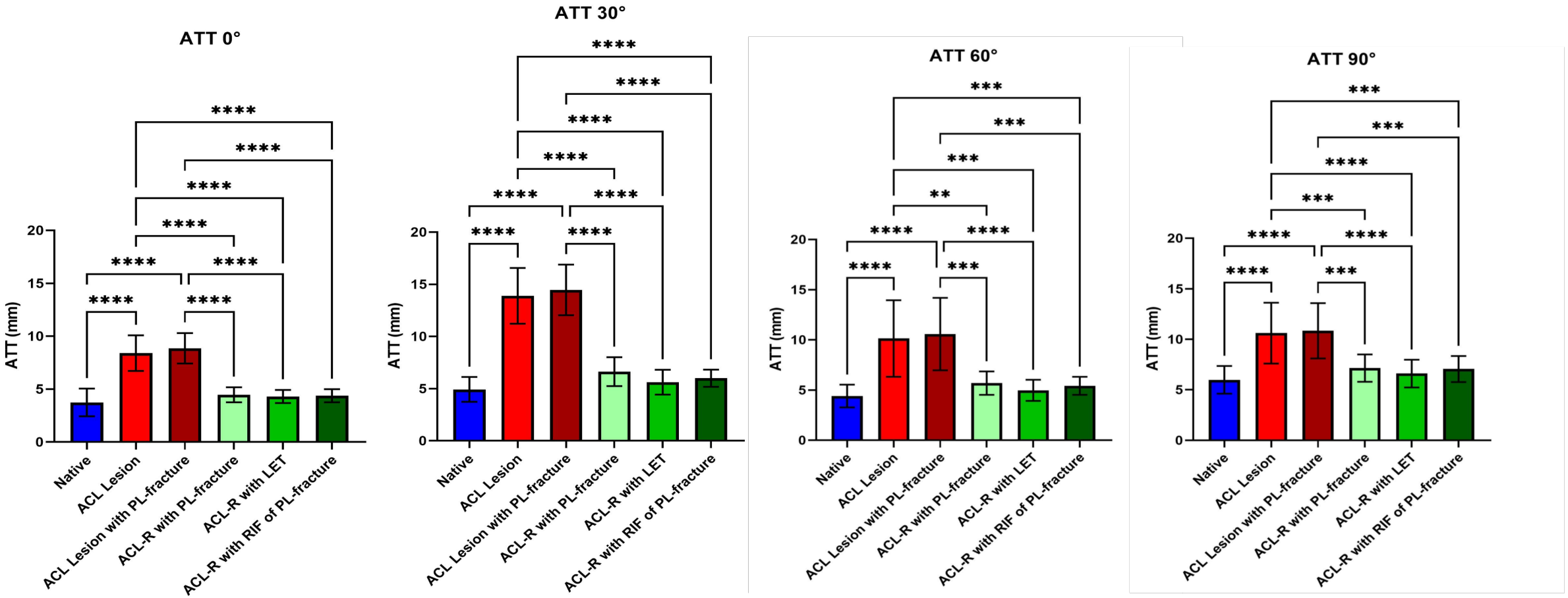
- Statistical analysis:

  - after testing for normal distribution, a linear mixed model was run for the comparisons of the individual test states

    - using Bonferroni-correction
    - $p \leq 0.05$ = significant

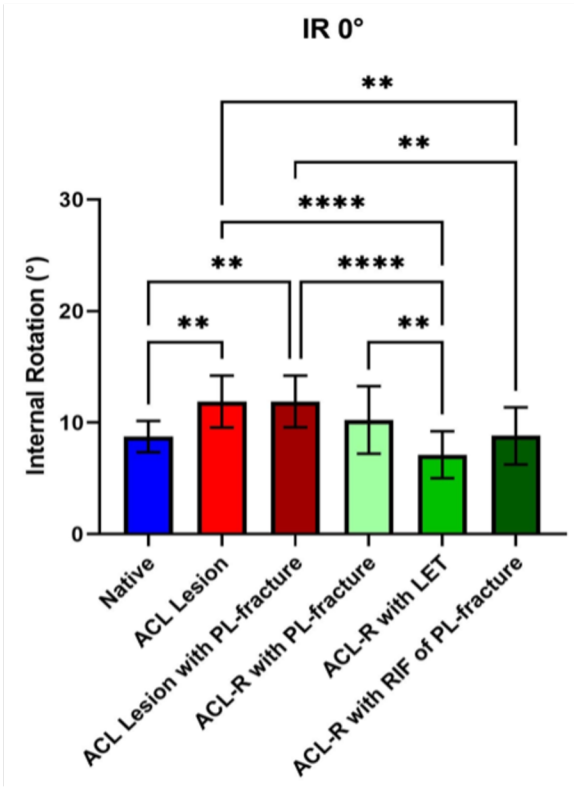
Results

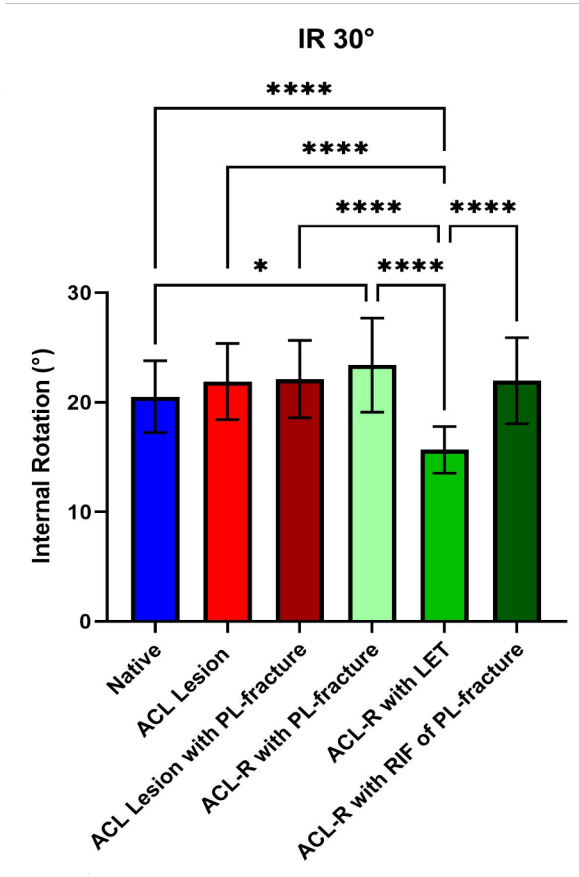
- **Anterior Tibial Translation:**
  - No significance between the reconstructed states and native state

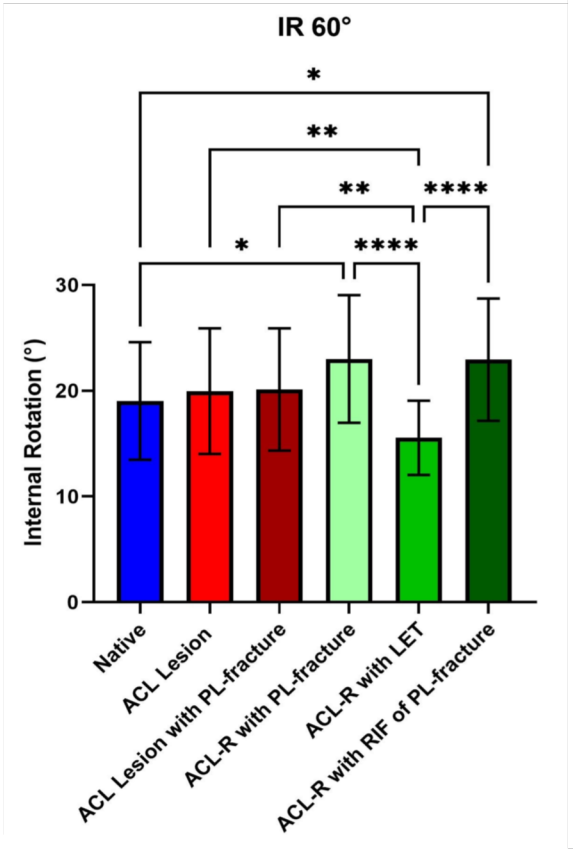


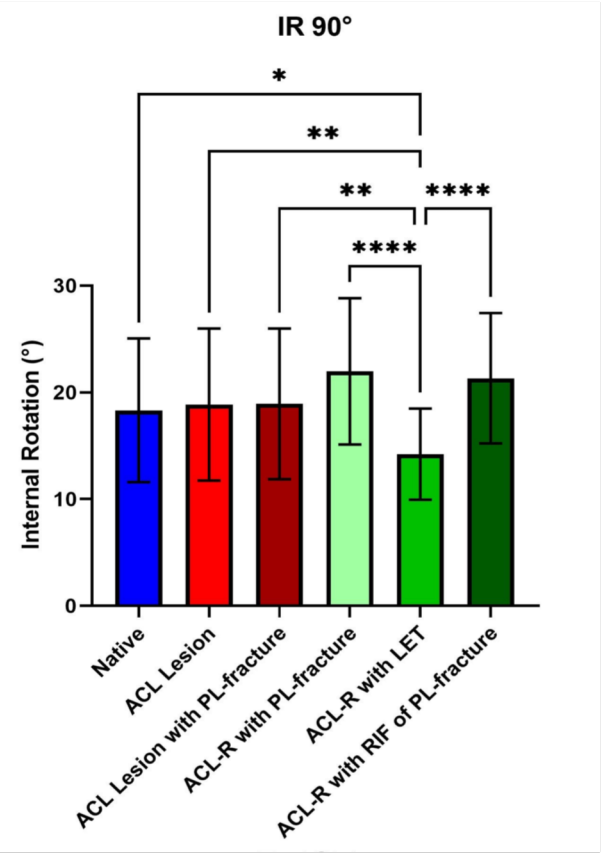
Results

- **Internal Rotation:**
  - No significant differences between native and the 3 reconstruction states at 0° flexion.



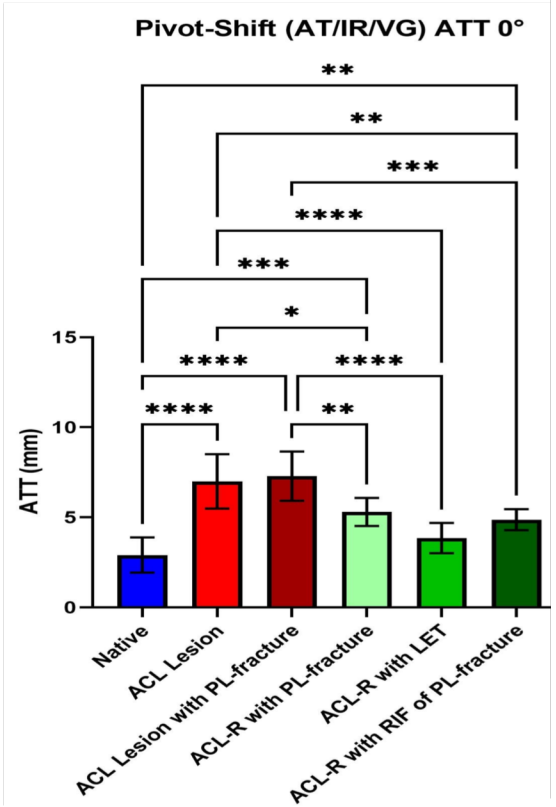


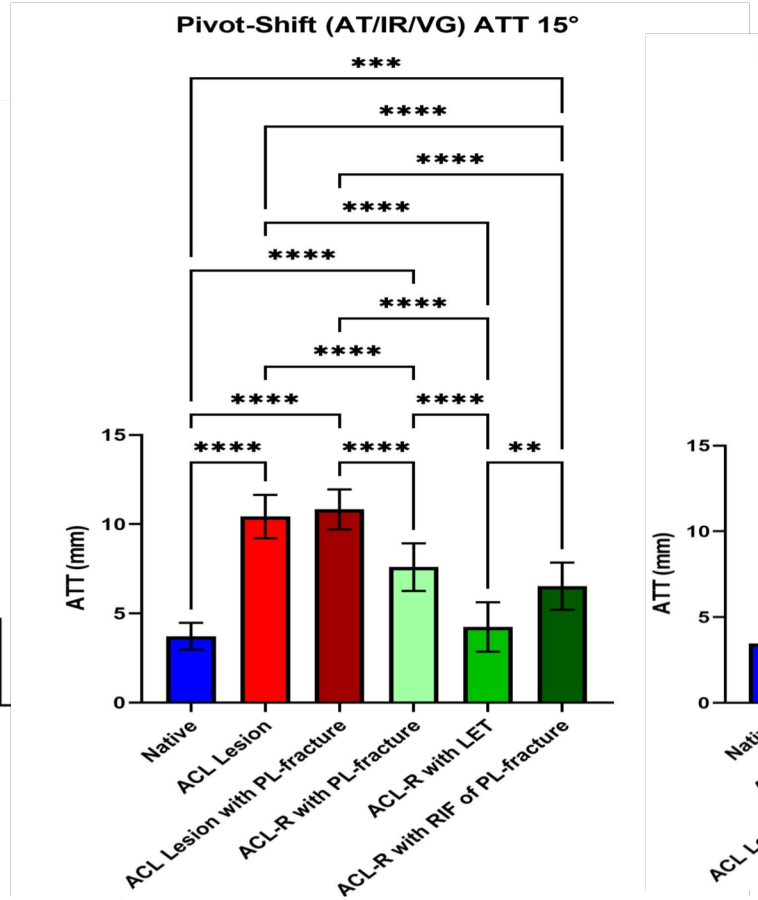


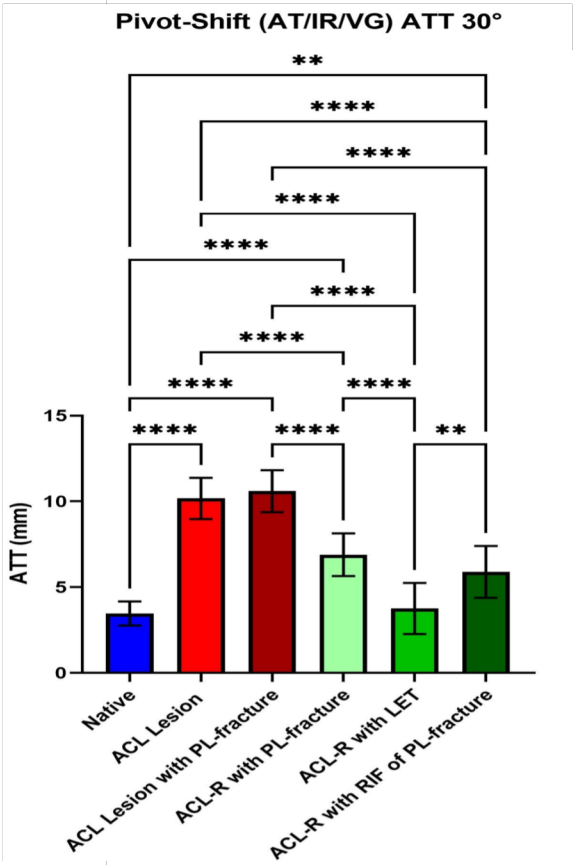


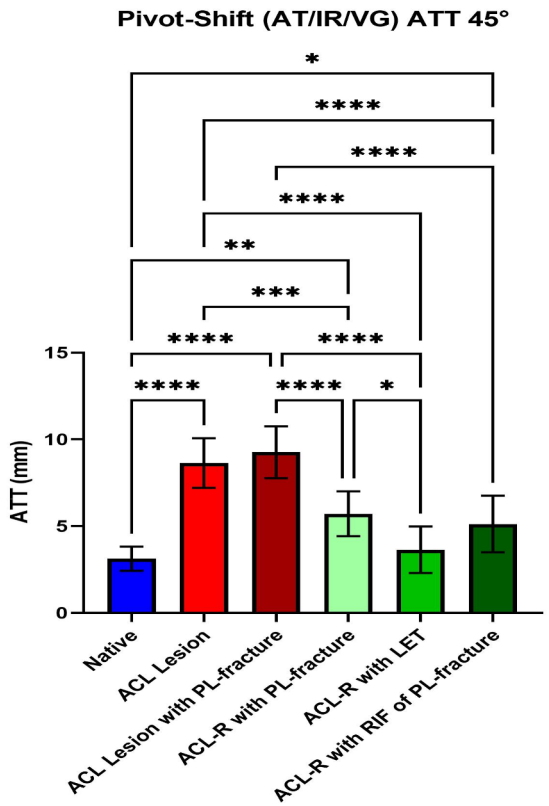
Results

- **ATT in simulated Pivot Shift Test (PS):**
  - ACLR with reconstructed PLTF showed a significant higher ATT compared to native state in 15° to 45°. In comparison, the ACLR with LET showed no significant differences to the native state in 0° to 45°.



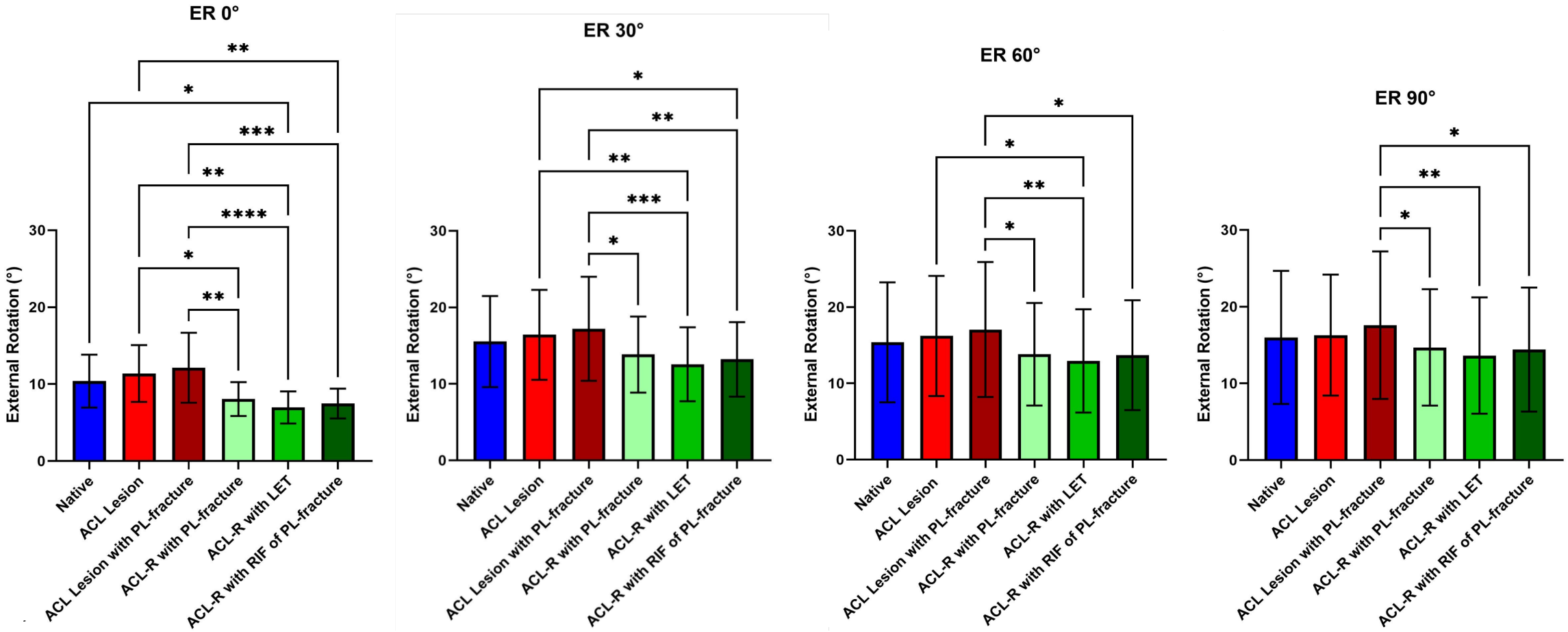






Results

- **External Rotation:**
  - was significantly reduced in 0° in the ACLR with ALT compared to native state



Limitations

- Cadaveric knees

- Possible reason for no significant difference between ACL rupture and PLTF:
  - Lower depth of the PLTF 3mm vs. 10mm
  - Lower axial load 50 N vs. 200 N

Menzdorf et al., ESTES, 2020
Herbort M, AGA, 2021

- Increase of internal rotation during ACL-R
  - Restoration of rotational stability
  - Possible femoral tunnel mal-positionning
  - High graft tensionning (80N)

Giffin et al., AJSM, 2004
Zantop et al., Schw. Z. Sportmed. Sporttraum, 2013
Loh et al., Arthroscopy, 2003
Tahara et al., AOTS, 2021

Conclusion

- The different reconstruction states show hardly any differences to the native state, except in the pivot shift test the ACLR or the ACLR with additional TPLF reconstruction show a significant difference compared to the ACLR + LET.

- ACLR with LET restores more native anterior translation, including in the simulated pivot-shift test.

- ACLR with LET carries the risk of an overall reduction in rotation compared to native knee kinematics. This particularly affects internal rotation.