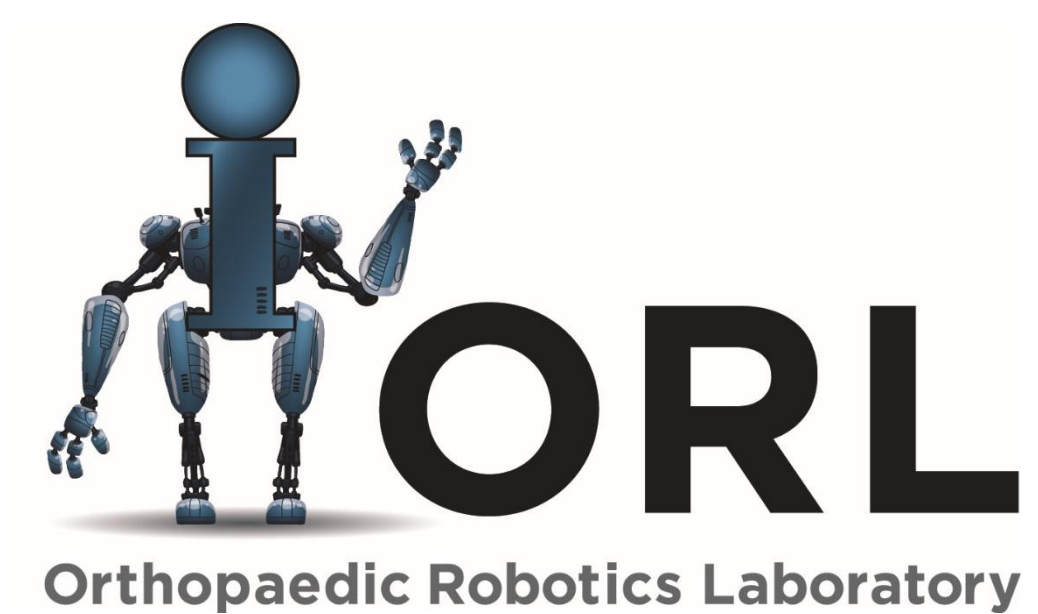




Knee Anterolateral Capsule Reconstruction with Semitendinosus Graft Decreases Anterior Cruciate Ligament Forces

Sene K. Polamalu¹, Justin W. Arner¹, João V. Novaretti^{1,2}, Calvin K. Chan¹, Volker Musahl¹, Richard E Debski¹, Bryson P. Lesniak¹

¹Orthopaedic Robotic Laboratory, Department of Orthopaedic Surgery, Department of Bioengineering, University of Pittsburgh, PA, USA; ²Orthopaedics and Traumatology Center (CETE), Department of Orthopaedics and Traumatology, Paulista School of Medicine (EPM), Federal University of São Paulo, Brazil



Introduction

The combination of lateral extraarticular tenodesis (LET) procedures with ACL reconstruction have been described to treat persistent rotatory laxity after ACL injury. Concern exists that LET procedures may over constrain the knee, as observed in biomechanical studies, preventing complete force restoration. LET procedure investigated in this study is an anterolateral complex (ALC) reconstruction.

Objective

Quantify the effects of an anterolateral capsule reconstruction procedure on ACL and ALC forces and knee kinematics

Hypothesis

- (1) ALC deficiency would increase in situ force in the ACL
- (2) ALC reconstruction would restore in situ forces in the ACL compared to the intact knee

Methods

- 9 fresh-frozen cadaveric knees (mean age 66.4 years) were tested using a 6-degree-of-freedom robotic testing system
- Loading Conditions: 200-N axial compression coupled with (1) 134-N anterior tibial load and (2) 7-Nm internal tibial torque, from 30° to 90° of knee flexion
- ALC deficiency simulated by removing a 2-cm-wide strip from anterior to the LCL to proximal and lateral to the Gerdy's tubercle
- ALC reconstruction performed utilizing a 6-mm semitendinosus graft placed according to the anterolateral ligament [8]
- Kinematic data was collected for these knee states:
 1. Intact
 2. ALC deficient (Fig. 1A)
 3. ALC reconstruction (Fig. 1B)
- In situ forces in ALC, LET graft, and ACL determined using the principle of superposition
- ANOVA with post-hoc Bonferroni test

Methods

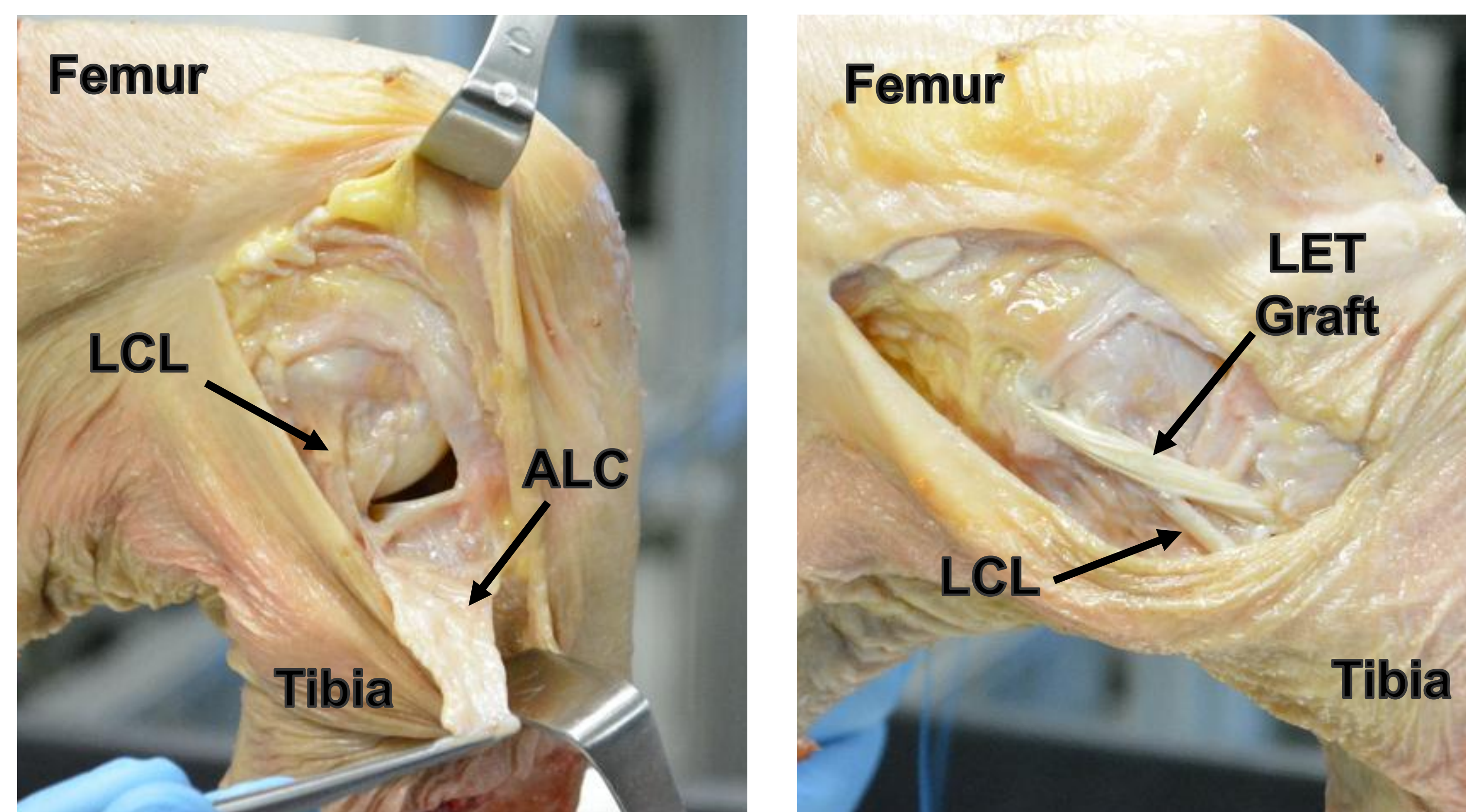


Figure 1: Surgical procedure; (A) A 2-cm-wide strip of ALC is removed to simulate ALC deficiency; (B) Lateral extra-articular tenodesis (LET) is performed utilizing a 6-mm semitendinosus graft.

Results

- In situ force in ACL decreased after ALC reconstruction compared to ALC deficient at 60° and 90°
- In situ force in ALC graft higher than in native ALC at all flexion angles in response to internal torque and axial compression

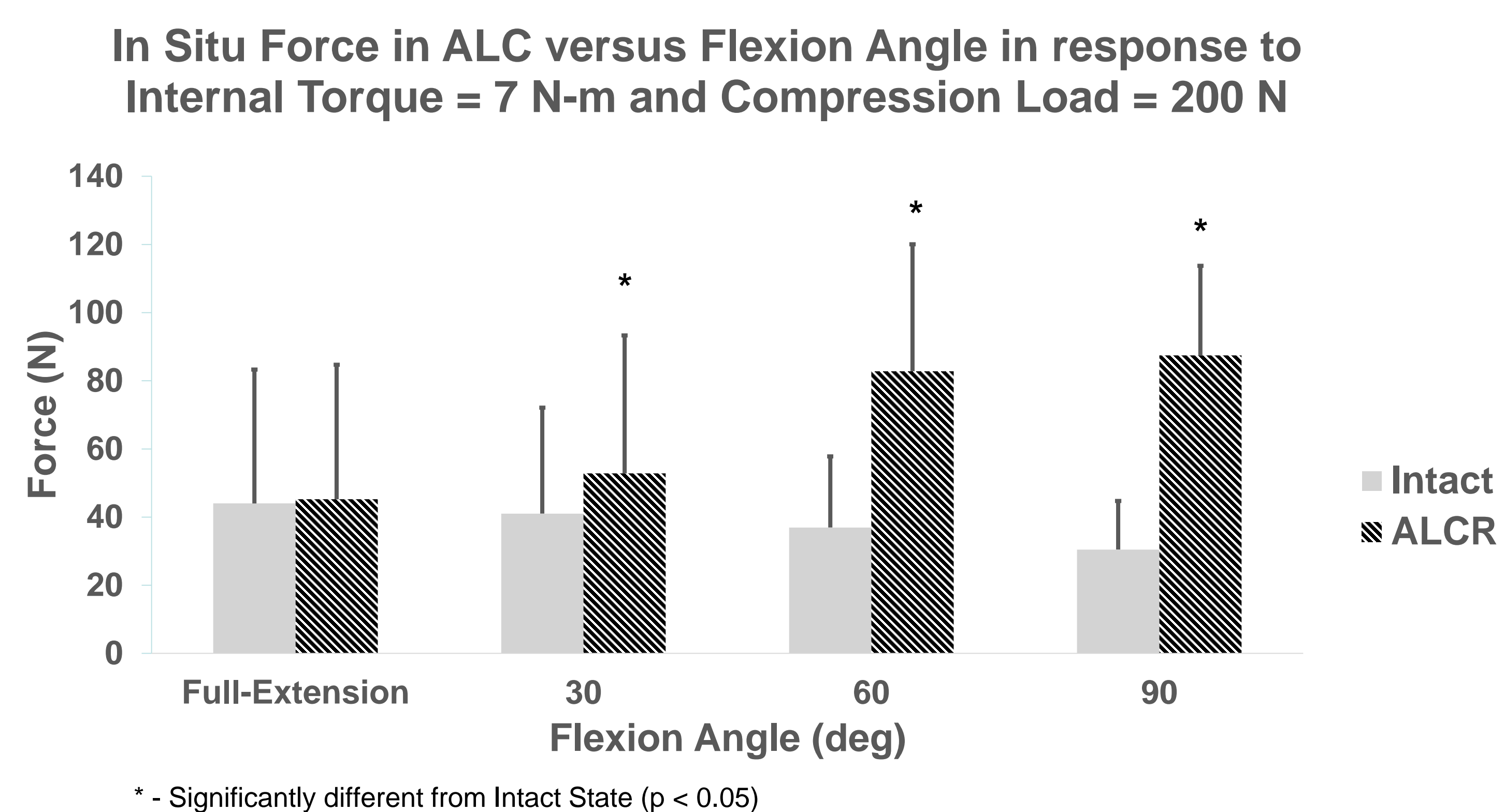
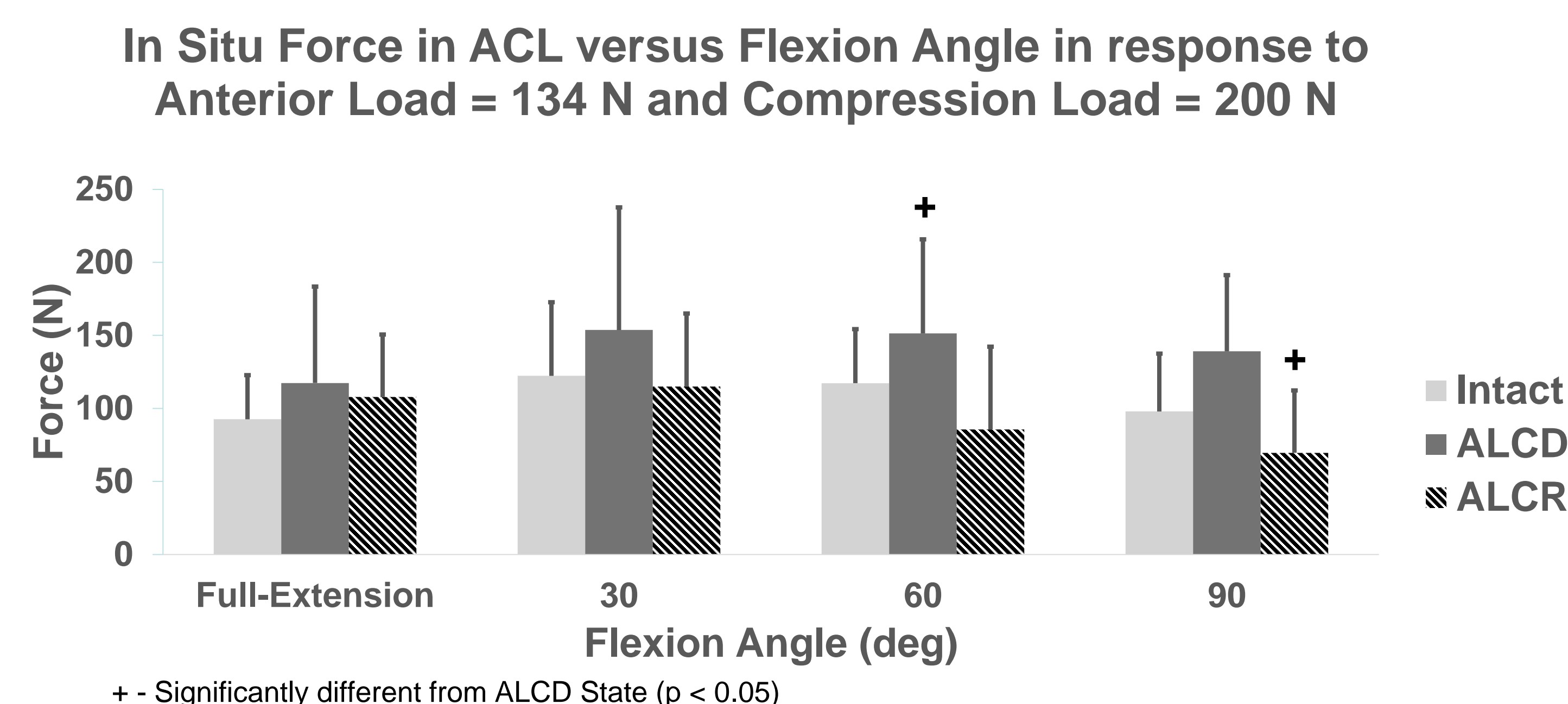


Figure 2: A) A) In situ forces in the ACL at each knee state (Means \pm SD) B) In situ forces in the native anterolateral capsule and graft (Means \pm SD) * $p < 0.05$

Discussion

- In situ forces in the LET graft were higher than the native ALC
 - LET graft may provide support for other knee structures from injury
 - LET graft may protect knee structures when ACL deficient
- No decrease in forces in ACL after ALC reconstruction
 - Lack of complete force restoration
 - ALC reconstruction may lead to over constraining
- No Differences in knee kinematics between the intact knee state and after ALC reconstruction

Future Direction

- Compare the effect of other types of LET procedures on in situ forces of the knee structures

Significance

- ALC reconstruction with a semitendinosus graft can reduce in situ forces in the ACL after ALC deficiency making it possibly protective of the ACL. However, this only occurred at limited flexion angles and loading conditions making further investigation necessary.

Acknowledgements

Support from the University of Pittsburgh, Swanson School of Engineering Office of Diversity, Department of Orthopaedic Surgery, and the Department of Bioengineering is gratefully acknowledged.

References

- [1] Spencer et al. Am L Sports Med, 2015
- [2] Chahla et al. Arthrosc Tech, 2016
- [3] Schon et al. Am J Sports Med, 2016
- [4] Geeslin et al. Am J Sports Med, 2017
- [5] Inderhaug et al. Am J Sports Med, 2017