# Project Title: Targets for Soft-tissue Balancing in Knee Replacement

**Lead University:** Denver  
**Principal Investigator:** Paul Rullkoetter  
**Team Members:** Clare Fitzpatrick  
**Budget:** 35k  
**Schedule:** 1yr

## Problem Statement:
Surgical alignment and balancing in total knee replacement impact patient mobility and stability. However, it is difficult to study in vivo and requires a computational + experimental approach. Through simulation we will determine the critical surgical parameters and estimate balancing targets for future use in intra-op sensors.

## Objective(s):  
- Estimate impact of balancing/alignment philosophy on knee mechanics during simulated ADL  
- Determine desired balancing targets for approaching natural knee stability/mobility

## Deliverables:  
Final Report

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**PROPOSAL SUMMARY**

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**Problem Statement:**
Surgical alignment and balancing in total knee replacement impact patient mobility and stability. However, it is difficult to study in vivo and requires a computational + experimental approach. Through simulation we will determine the critical surgical parameters and estimate balancing targets for future use in intra-op sensors.
Clinical data clearly suggests that ligamentous balancing is important to patient outcome, but it is historically a difficult problem – balance state generally unknown post-operatively, therefore no clear link to mechanics or performance/outcome.
However, new intra-operative sensors have begun to quantify balance, but targets for performance are not clear.
• RQ: How significant is soft-tissue balance, and what is the best target to recommend? Is this design specific?

1. Baseline calibration of computational soft tissue representation from cadaveric testing (input from another university collaborator)

2. Optimize balance to best achieve natural knee passive stability

3. Evaluate impact of balance state on joint mechanics during ADL
1. Calibration of soft-tissue representation with combined cadaveric laxity testing and M/L force balancing during total knee replacement
2. Optimize balance to best reproduce natural knee passive stability.
3. Evaluate impact of balance state on joint mechanics during ADL

• Previous study: In vivo TKR kinematic evaluation of gait, step down, deep squat, chair rise
3. Evaluate impact of balance state on joint mechanics during ADL
   • Musculoskeletal analysis provides estimates of muscle force requirements and joint contact loading for the measured ADL
3. Evaluate impact of balance state on joint mechanics during ADL
   • Significance, critical parameters, recommendation
INNOVATION & UNIQUENESS

• Improved representation of passive soft-tissue constraint for TKR
• Significant multifaceted input from in vivo data acquisition in gait lab, cadaveric testing, and musculoskeletal modeling
• New insight into significance and targets for balancing
Task 1: Baseline calibration of computational soft tissue representation – Q2 2016
Task 3: Evaluate impact of balance state on joint mechanics during ADL – Q4 2016