# The Effects and Influences of Localized Muscle Vibration on Landing Biomechanics Linked to Anterior Cruciate Ligament Injury

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## BACKGROUND

- Secondary anterior cruciate ligament (ACL) injury risk is greater than primary ACL injury risk in healthy controls.
- Secondary ACL injury risk is greater in ACLR patients with hamstring grafts compared to patellar tendon and quadriceps tendon grafts.
- Individuals with ACL reconstruction (ACLR) utilizing a hamstring tendon autograft display hamstring dysfunction.
- Landing biomechanics are strong predictors of secondary ACL injury risk.
- Hamstring dysfunction is associated with poor landing biomechanics linked to ACL injury risk.
  - i.e. smaller peak knee flexion angles and greater knee valgus/abduction angles and moments
- Local muscle vibration (LMV) improves quadriceps function and gait biomechanics in individuals with ACLR.
- LMV may also enhance hamstring function and landing biomechanics linked to secondary ACL injury risk.

## PURPOSE

**Purpose:** To determine the acute effects of LMV on landing biomechanics linked to secondary ACL injury risk

**Hypothesis:** LMV will cause acute improvements in hamstring muscle function that will result in improved landing biomechanics

## METHODS

### Study Design

- This study consisted of two sessions separated by 1-14 days in which landing biomechanics were assessed prior to and following a control intervention or LMV.
- A counterbalancing scheme determined intervention order.

### Participants

- Eight healthy control individuals (age = 21.1 ± 1.9 years) with no history of lower limb surgery participated.

### Single Leg Landing Biomechanics

- Participants completed 3 SL landing trials for their dominant limb upon an embedded force plate from a 30 cm high box located half their height away and maintained balance for 10 seconds upon landing (Figure 1).
- 3D kinematics of the lower extremity were recorded using a 10-camera motion capture system
- Landing Biomechanics outcomes include the peak knee flexion and abduction angles, and the peak internal knee adduction moment during the impact phase (vertical ground reaction force >20N to peak knee flexion angle).

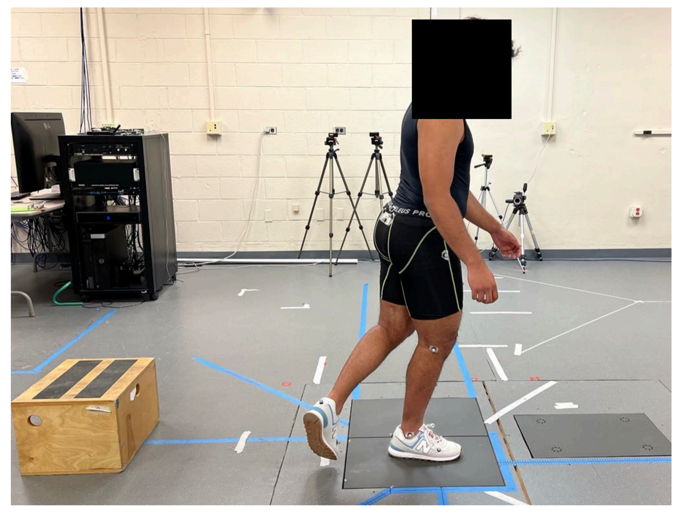

**Figure 1.** Single leg (SL) landing

### Interventions

- Participants stood in a half-squat with the LMV device positioned over the hamstrings
- LMV (2*g* of acceleration at 30Hz) was delivered for 60 seconds 6 times (Figure 2).
- The Control intervention was identical with the exception that no vibration was delivered.

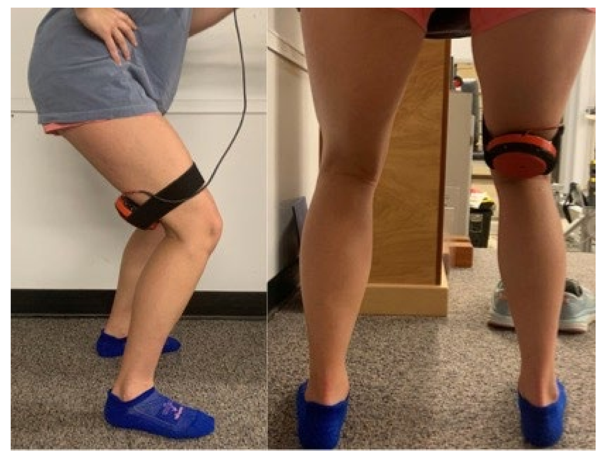

**Figure 2.** Local muscle vibration intervention

### Statistics

- Change scores (post – pre) calculated for each outcome and intervention (Control and LMV)
- Change scores compared between interventions via one-way repeated measures ANCOVA controlling for average pre-test scores from control and LMV sessions
- Statistical significance was set *a priori* at *P value* ≤ 0.05.

## RESULTS

- No significant change scores were found for any of the landing biomechanics variables ($P$ = 0.393 - 0.740)

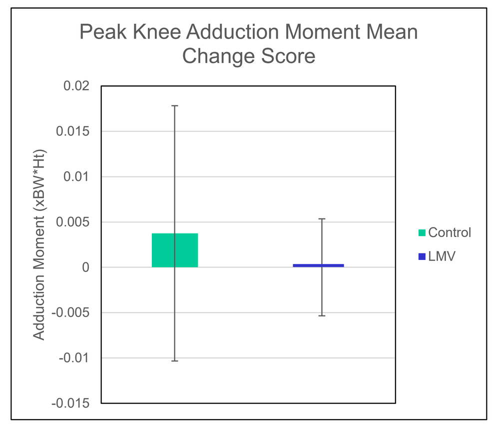


**Figure 3.**

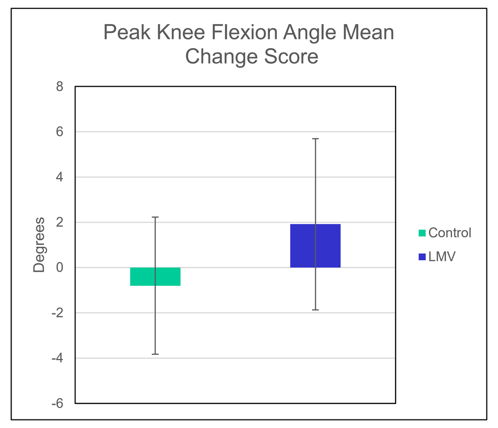


**Figure 4.**

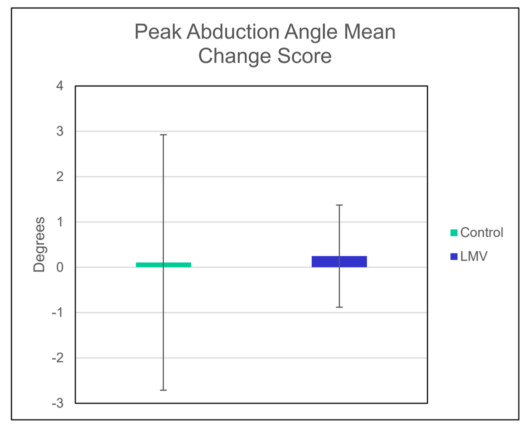


**Figure 5.**

**Figures 3, 4, 5:** Mean change scores peak internal knee adduction moment, peak knee abduction angle, and peak knee flexion angle. Green boxes represent the change score for the control intervention, while blue boxes represent the mean change score for LMV. Error bars = ± 1 sd.

## DISCUSSION

- LMV did not influence SL landing biomechanics during impact phase in healthy controls.
- However, it is still possible that LMV may minimize aberrant landing biomechanics in patients with dysfunctional hamstrings following ACLR.
- Ceiling effects may have inhibited the landing biomechanics effect sizes in healthy controls.
- Power analysis revealed that large samples would have been needed for effect size to be significant (n = 64-125)
- Future studies should examine the effect of acute and repeated LMV treatments on landing biomechanics in those with ACLR utilizing a hamstring tendon autograft.

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