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4-27-2020

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Recommended Citation

Graff, M., Clark, K. P., Smith, J. J., & Cattano, N. M. (2020). The Effects of Lower Body Positive Pressure Treadmill Running on Acute Femoral Cartilage Deformation. Retrieved from https://digitalcommons.wcupa.edu/spomed_stuwork/2

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The Effects of Lower Body Positive Pressure Treadmill Running on Acute Femoral Cartilage Deformation

BACKGROUND

- Lower body positive pressure treadmills (LBPPT) are treadmills designed to unload the body and musculoskeletal load of walking and running.
- LBPPTs have emerged as popular rehabilitation and training tools.
- The effects of LBPPT unloading on articular cartilage are not known.
- Cartilage composition is dependent on composition of the extracellular matrix.(ECKSTEIN)
- Acute femoral cartilage deformation may be used as a surrogate measure of cartilage composition. (Har)
- Ultrasound has been used as a tool for assessing acute femoral cartilage deformation

PURPOSE

- To examine and compare the acute response of femoral cartilage in healthy individuals after running at full body weight (100%) and 80% body weight (BW) on a LBPPT.

METHODS

Research Design

- Crossover design
- Independent variable
 - Exercise protocol
- Dependent variables
 - Acute femoral cartilage deformation

Setting

- West Chester University

Participants

- 20 physically active, healthy individuals
- West Chester University students
- Age 18 through 25

Instrumentation

- Alter-G Via X
 - LBPPT
- GE Logiq e NEXTGEN 7
 - High frequency ultrasound unit, with 12 MHz linear probe

Data Collection Procedures

- Pre-exercise Protocol
 - Participants were fitted with Alter-G shorts
 - Sat in a long sit position for 30 minutes to allow for full recovery of any cartilage deformation from previous activity that day
- Baseline cartilage measurements were taken
- Participants began the randomly assigned exercise protocol
 - 100% BW at 2.68 m/s for 30 minutes
 - 80% BW at 2.68 m/s for 30 minutes
- Post-run cartilage measurements were taken
- Each participants ran both conditions, exactly one apart, at the same time of day
- The same pre-exercise protocol was used for each trial

Data Analysis

- Dependent T-tests
- $\alpha = .05$

RESULTS

- A significant reduction of cartilage width was found in the medial compartment of both the right ($p=0.048$) and left ($p=0.030$) limb, intercondylar compartment ($p=0.005$) of the right limb, and lateral compartment of both the right ($p=0.024$) and left ($p=0.045$) limb.
- Baseline cartilage measurements were comparative between each running condition and limbs.
- A significant reduction in cartilage width was seen after running at 80% BW in the right lateral compartment ($p=0.006$).
- No other cartilage compartment showed significant decrease in width after running at 80% BW.

Figure 1. Left Medial Compartment Average Cartilage Width (mm)

	100	80	CI	P value
Pre	43.08 ± 19.62	43.12 ± 18.46	-2.91 – 2.82	0.974
Post	39.04 ± 15.71	43.32 ± 19.34	-9.08 – 0.54	0.079
CI	0.43 – 7.63	-2.70 – 2.31		
P value	0.030*	0.873		

Mean ± SD, mm = millimeters, CI = confidence interval. Columns denote within conditions; Rows denote between conditions. *Indicates significance at the 0.05 level.

Figure 2. Ultrasonographic image of femoral articular cartilage with landmarks and measurement sites for each compartment (medial, intercondylar, and lateral).

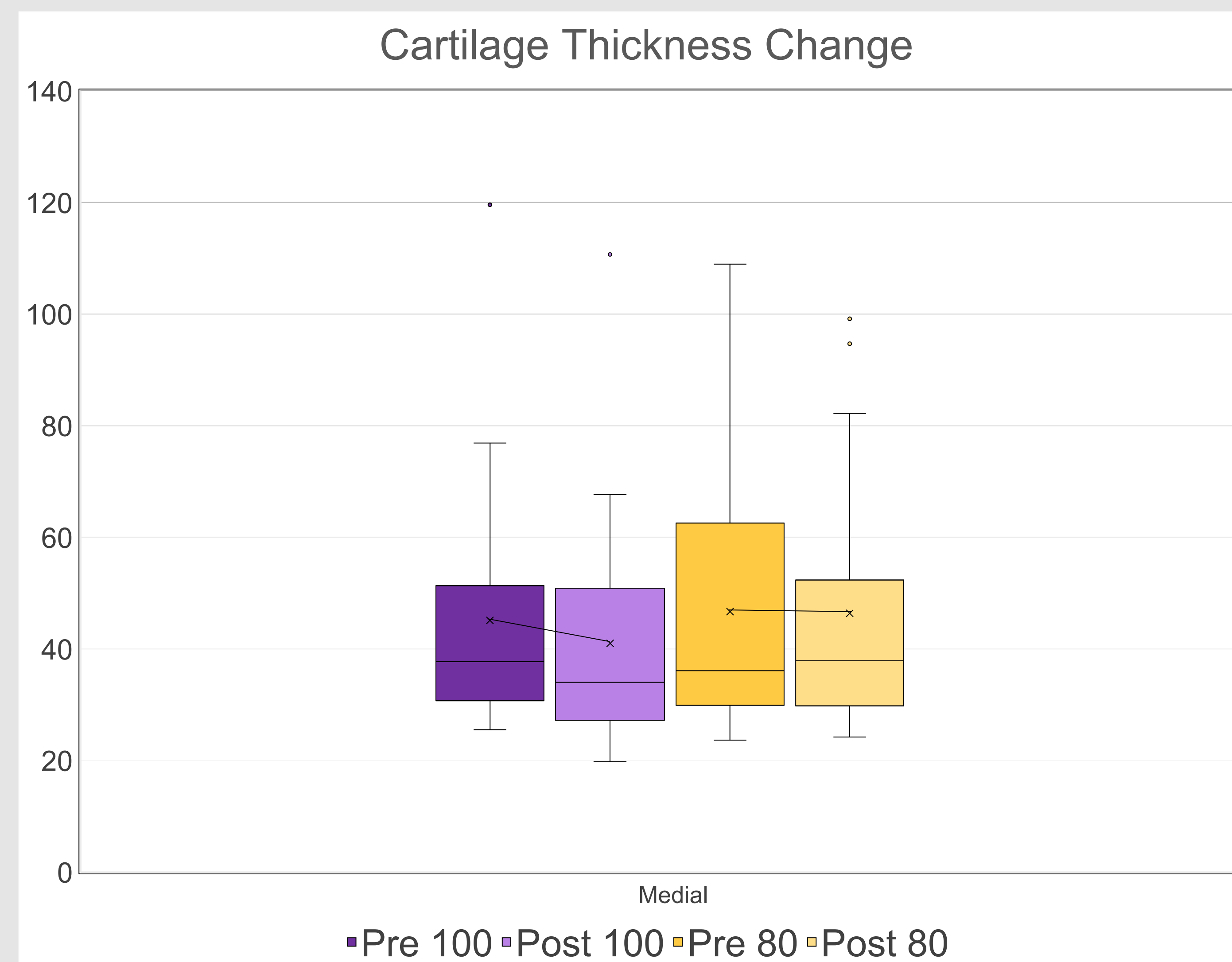
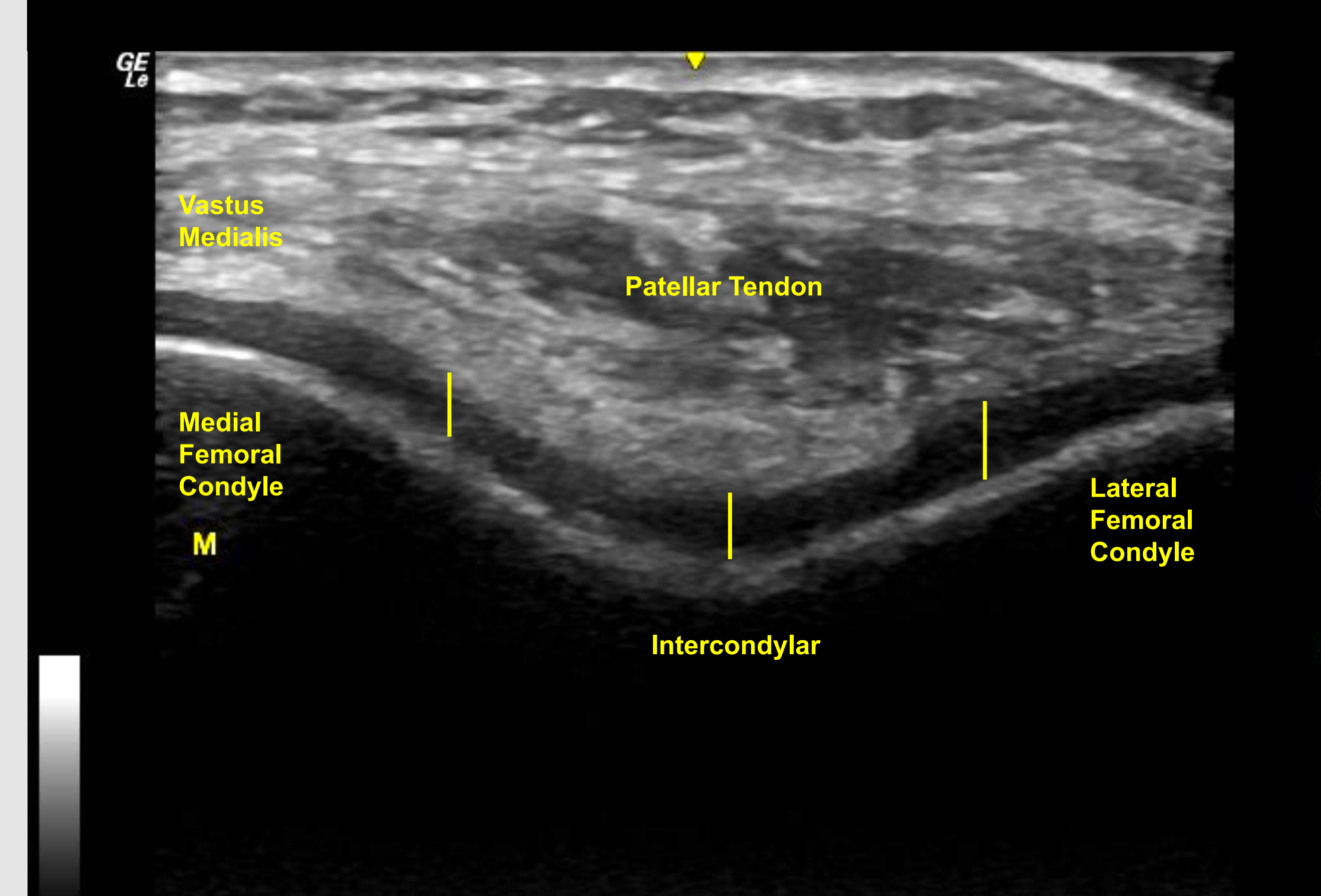


Figure 3. Baseline and post activity cartilage thickness measurements of the left medial compartment for each body weight condition. Line within conditions shows cartilage deformation for that condition.

DISCUSSION

- This is the first study assess acute femoral cartilage deformation after running unweighted on an LBPPT
- Running at 100% BW lead to significant deformation of all compartments of femoral articular cartilage which is consistent with
 - MRI results of Boocock et al. and Lad et al.
 - MRI and serum biomarker results of Niehoff et al.
 - Ultrasonographic results of Harkey et al.
- Running at 80% BW lead to no significant deformation of the medial and intercondylar compartments of femoral articular cartilage.
 - Consistent with serum biomarker findings of Denning et al.
- Only the lateral compartment of the right limb showed significant cartilage deformation after running at 80% BW.

CONCLUSION

- Running at 80% BW on a LBPPT unloaded the musculoskeletal system an adequate amount to decrease acute femoral cartilage deformation, compared to 100% BW.
- These results provide support for the use of LBPPTs in rehabilitation and athletic performance training in populations looking to reduce musculoskeletal load and accompanying stress on the femoral articular cartilage.

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