



Ground Reaction Force Alterations Due to Experimentally-induced Anterior Knee Pain During Walking

Matthew K. Seeley, A. Wayne Johnson,
Jihong Park, Daniel King, and J. Ty Hopkins

Human Performance Research Center
Brigham Young University





INTRODUCTION

- Knee pain is common: 1/2 of Americans will suffer knee pain and related costs are nearing 20 billion dollars (Gottlob et al., 1999; Murphy et al., 2008)
- Knee pathology usually includes pain, swelling, muscle inhibition and atrophy, joint instability, and altered biomechanics
- Although pain is a primary symptom of knee pathology, the independent influence of pain on movement mechanics is unclear





PURPOSE

- The purpose of this study was to evaluate the influence of experimentally-induced anterior knee joint pain on ground reaction forces (GRF) during walking
- We hypothesized that experimentally-induced anterior knee pain would result in: (1) increased vertical GRF and (2) decreased stance time





METHODS

- Twelve subjects (6 male, 6 female; age = 23 ± 3 yrs; height = 1.73 ± 0.09 m; mass = 75 ± 14 kg) walked under 3 conditions:
 1. Pain—hypertonic saline (5.0% Na)
 2. Sham— isotonic saline (0.9% Na)
 3. Control—no saline
- Saline (6 ml) was infused over 20 minutes



METHODS



For each condition:

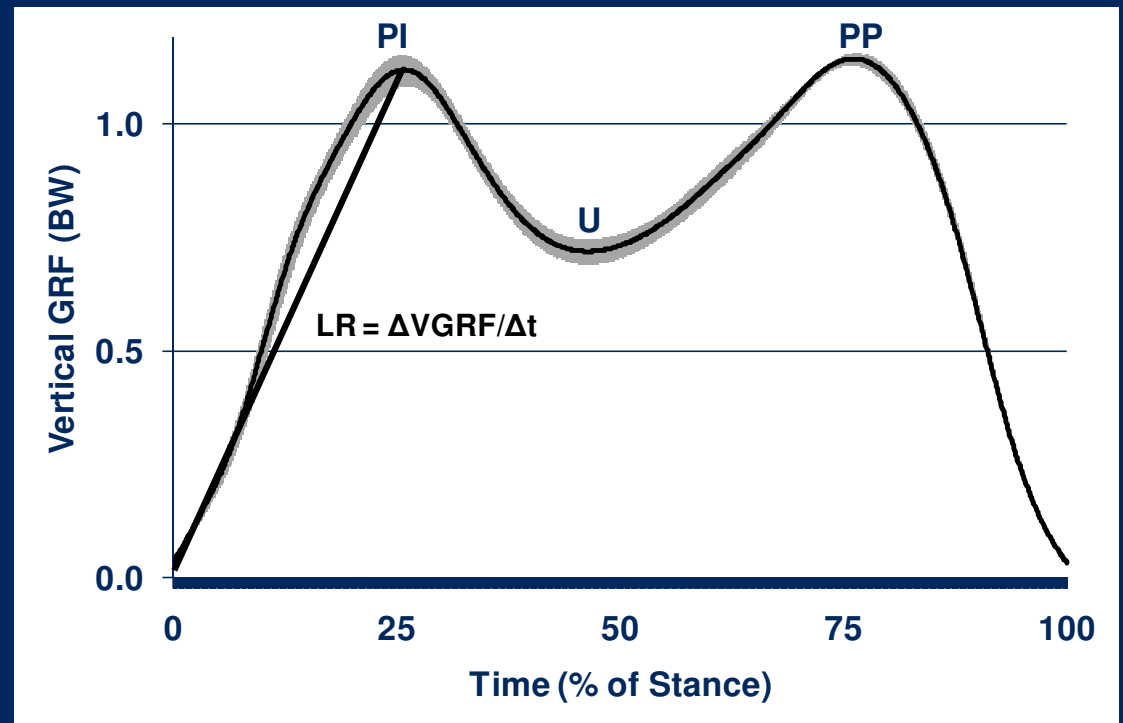
1. 3 baseline walking trials were performed (Time 1)
2. Infusion was initiated (painful and sham conditions)
3. 15 minutes later, 3 more walking trials were performed (Time 2)
4. Catheter was removed
5. 20 minutes later, 3 more walking trials were performed (Time 3)



Methods

Dependent variables:

1. Subject-perceived pain
2. Walking speed
3. Peak impact force (PI)
4. Peak impact force loading rate (LR)
5. Unloading force (U)
6. Peak push-off force (PP)
7. Stance time



DATA ANALYSIS



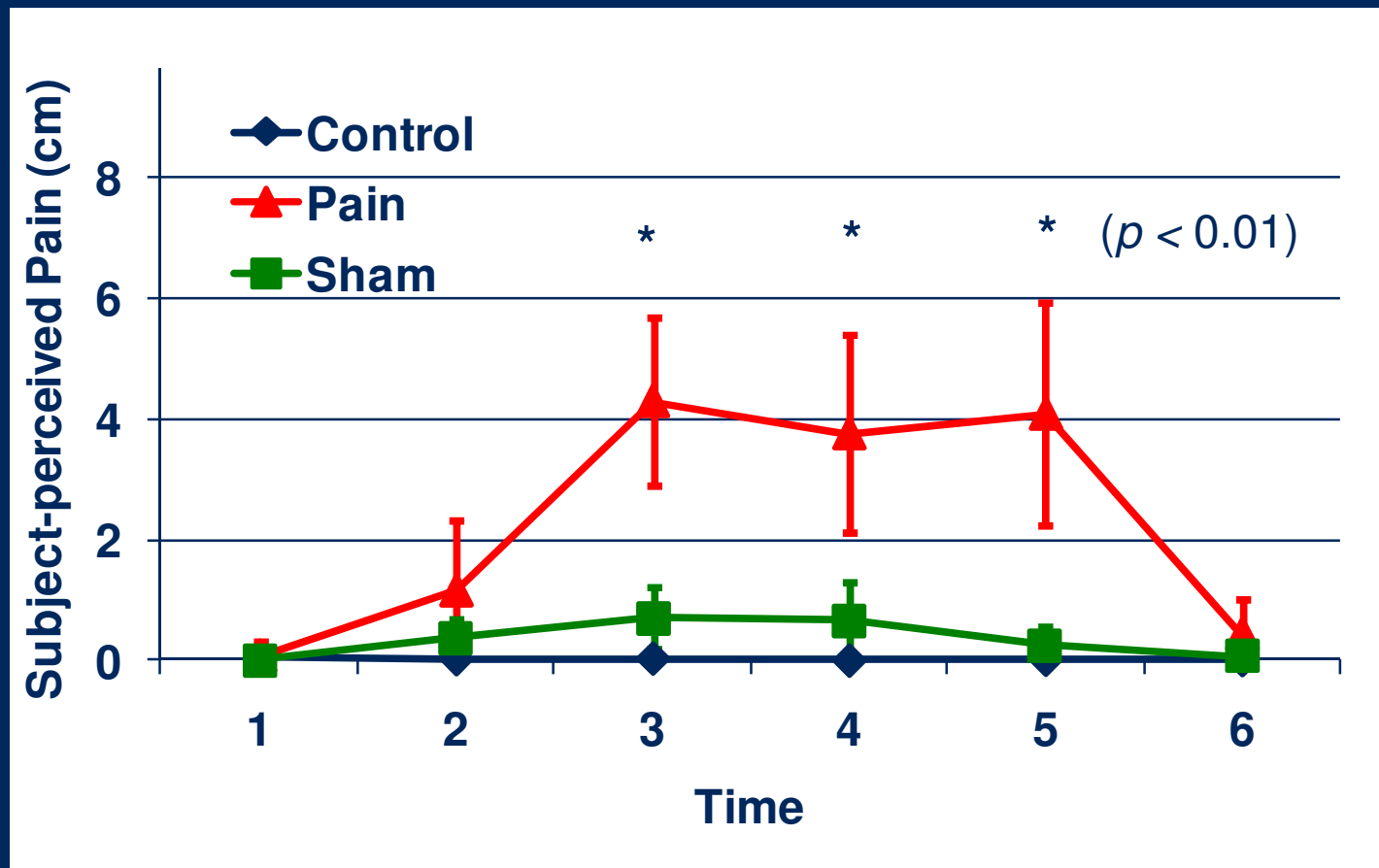
- Normalized GRF were averaged for each time (time 1, time 2, and time 3) and condition (pain, sham, and control), for each subject
- Repeated measures ANOVA ($\alpha = 0.05$) was used to detect differences among times, among the three different conditions
- Tukeys *post hoc* analyses were also used



RESULTS



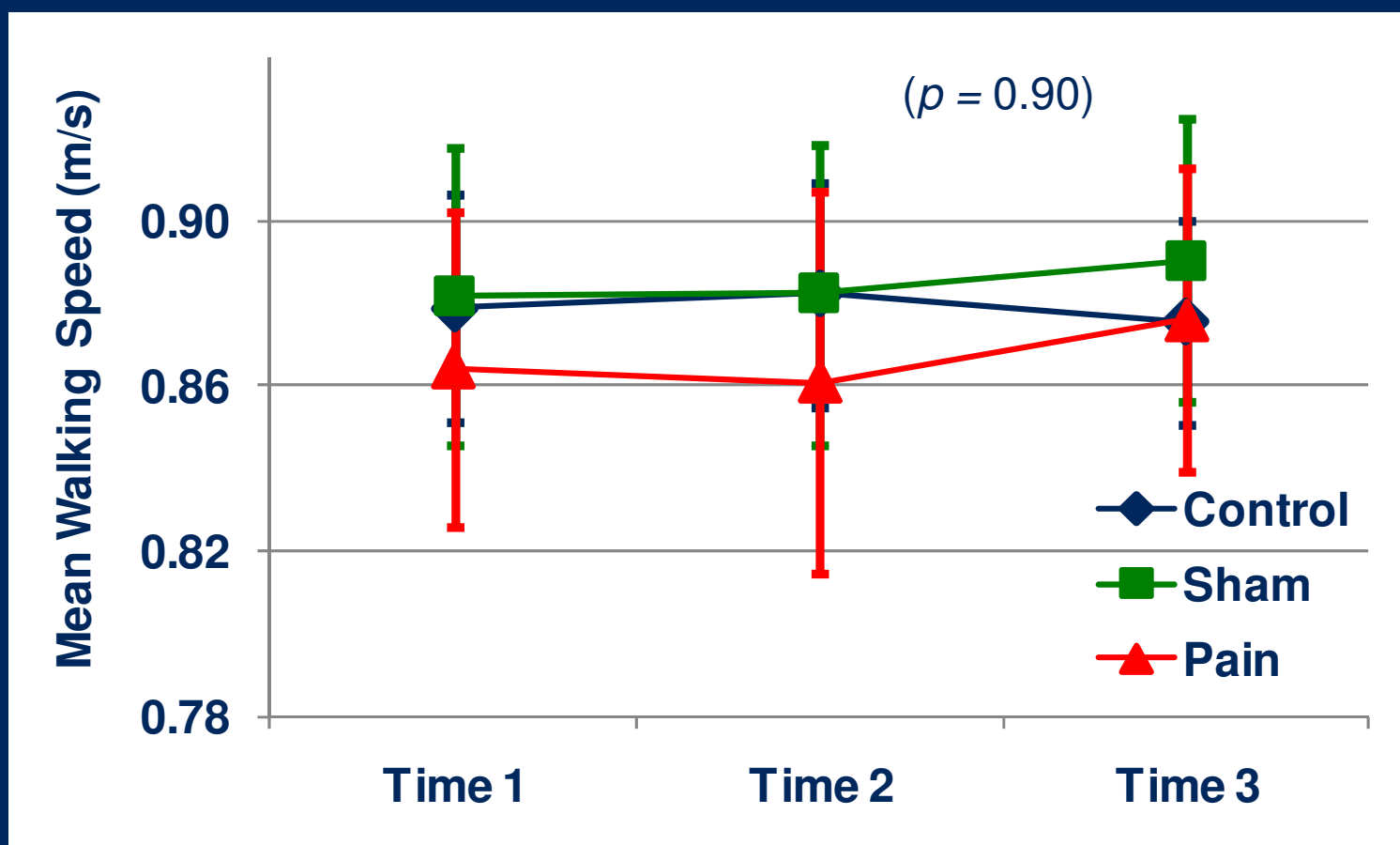
A condition \times time interaction existed for subject-perceived pain level



RESULTS

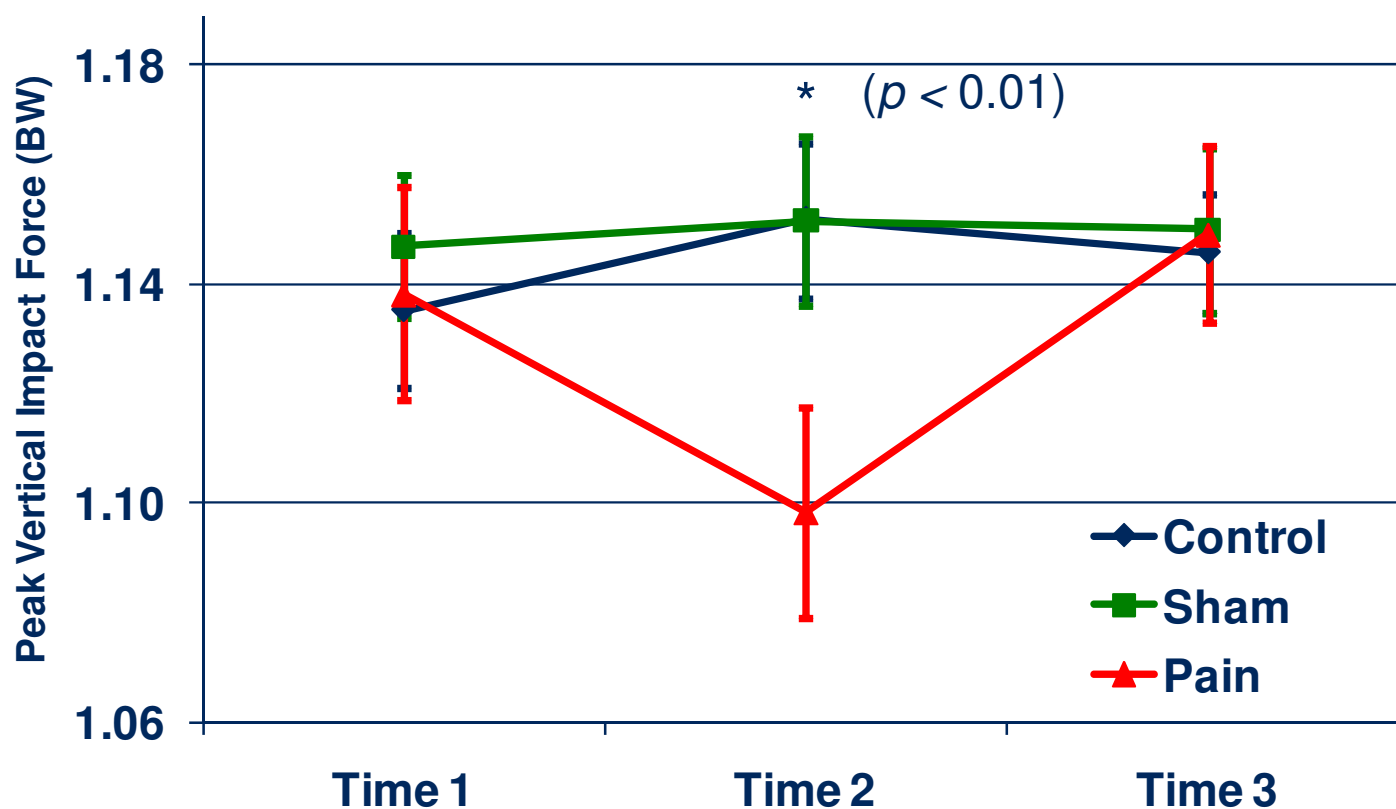


A condition \times time interaction did not exist for walking speed



RESULTS

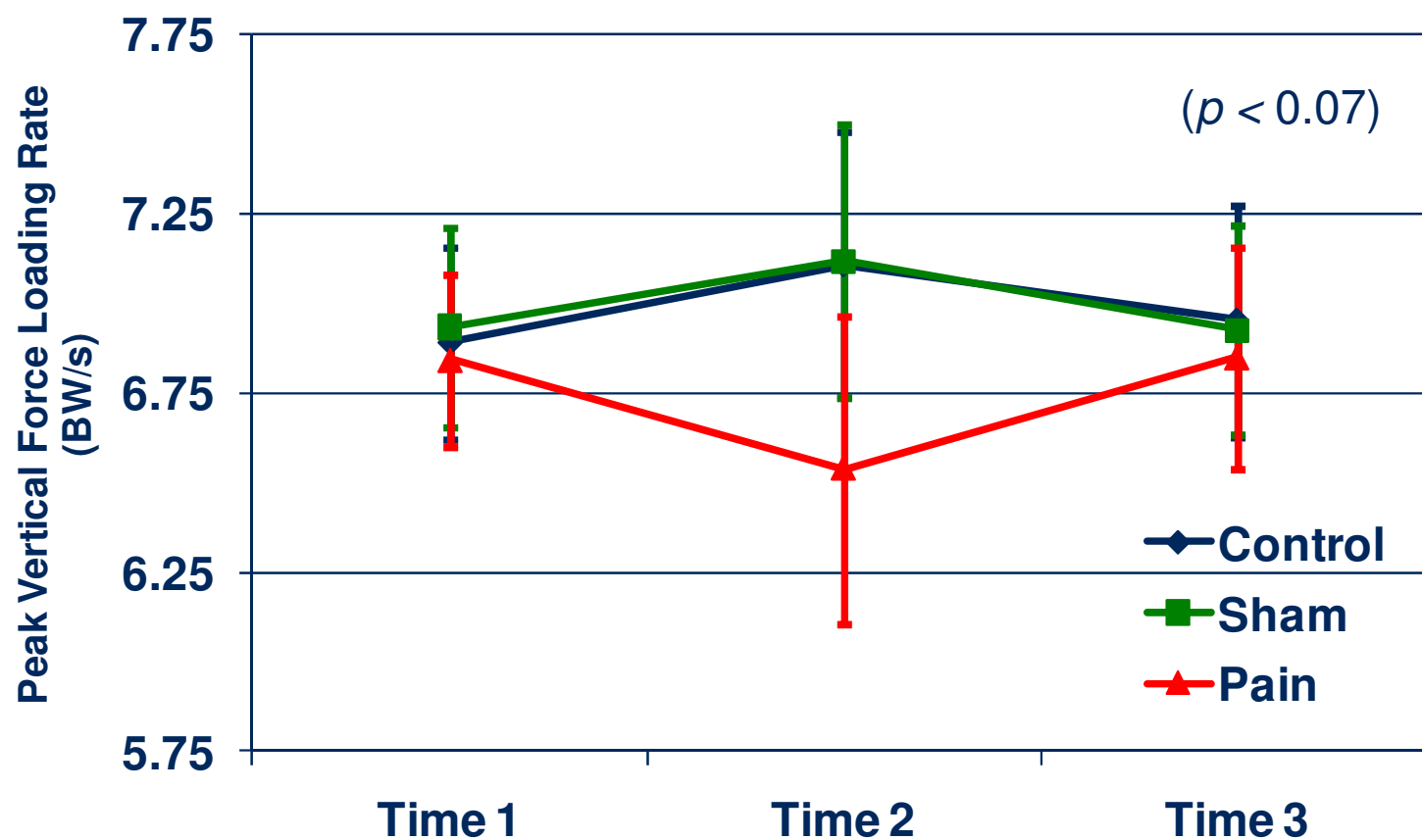
Experimentally-induced pain resulted in decreased peak impact GRF during Time 2



RESULTS

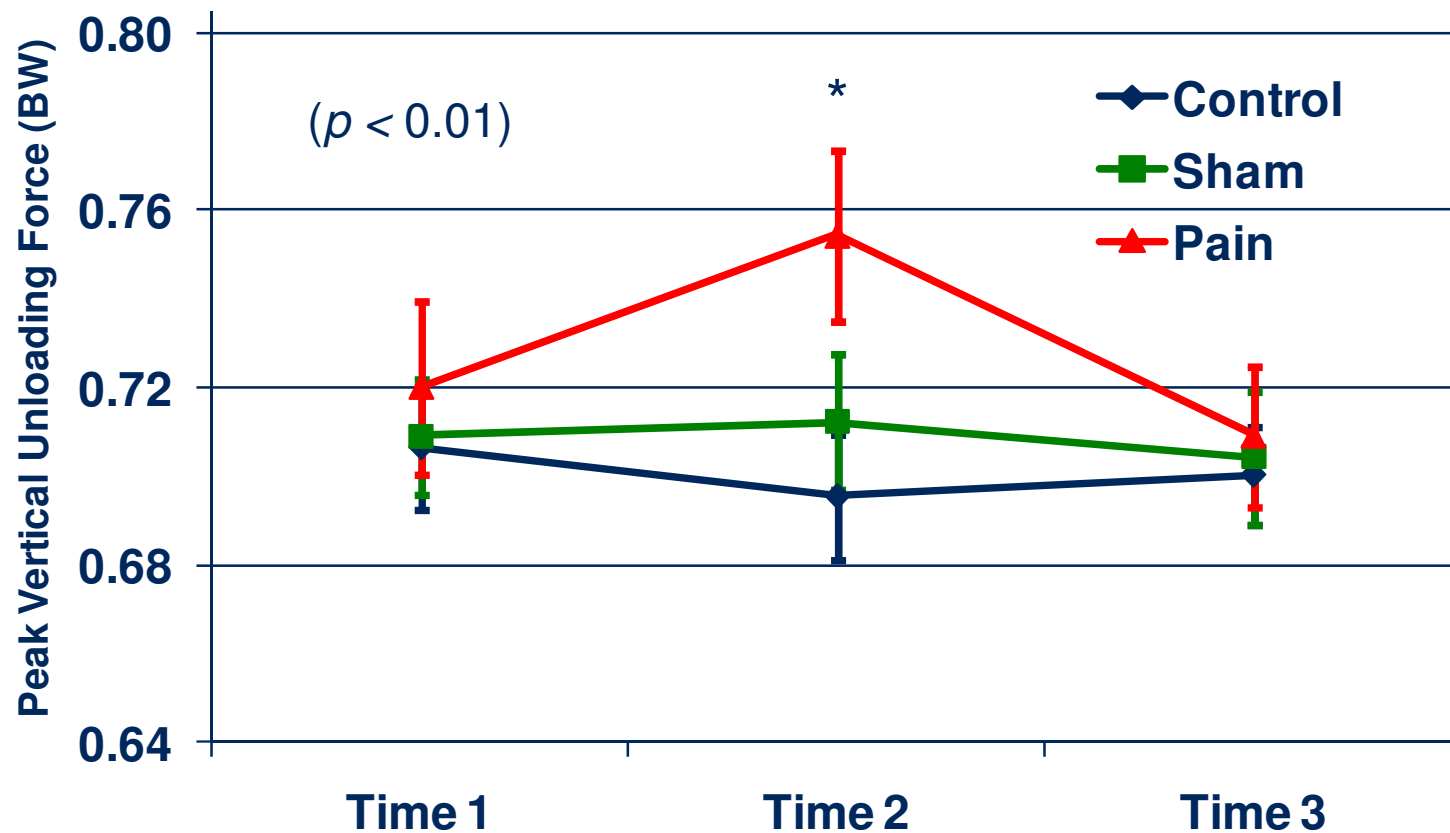


Impact GRF loading rate was not influenced by experimentally-induced pain



RESULTS

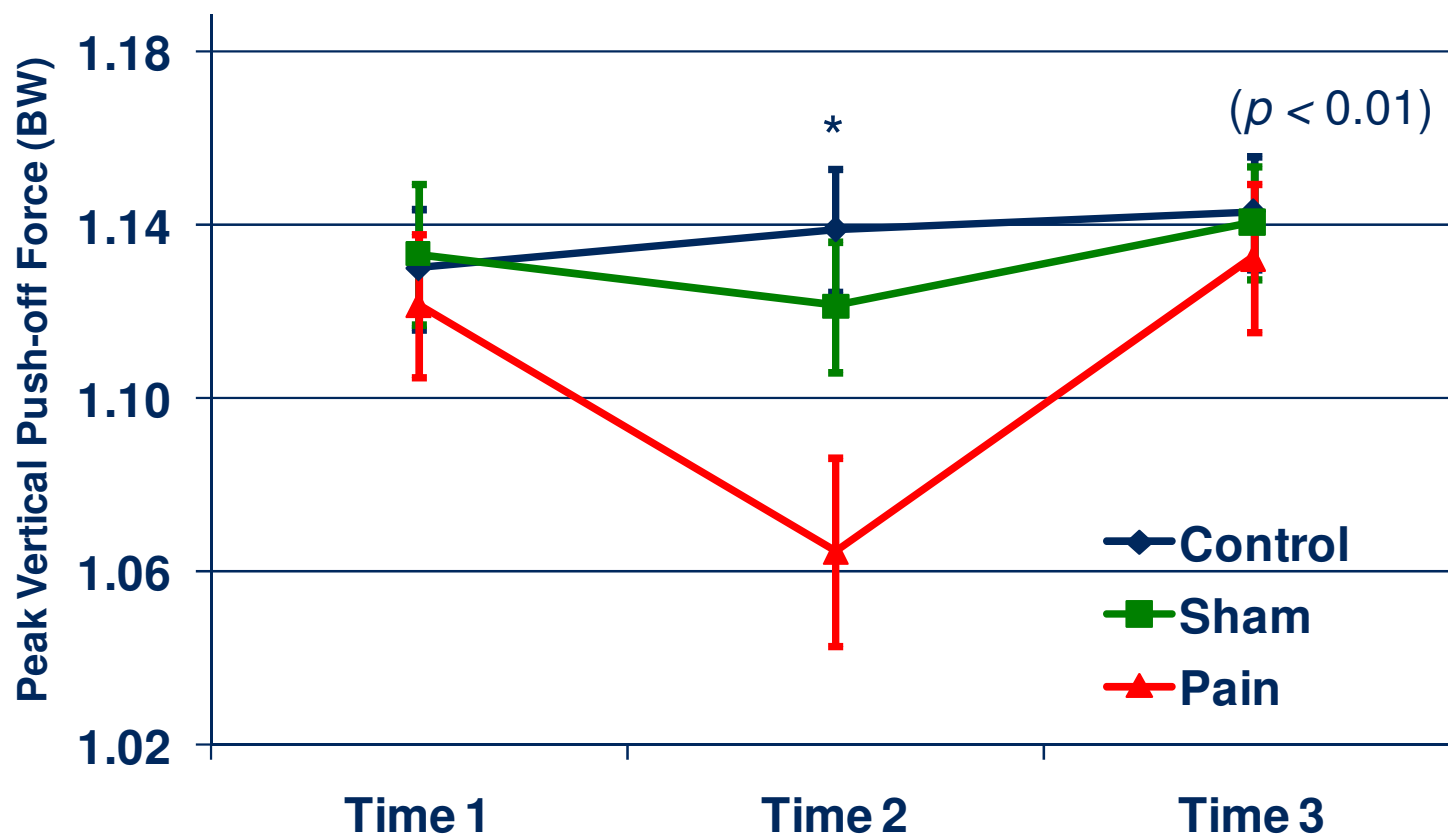
Experimentally-induced pain resulted in an increased unloading GRF during Time 2



RESULTS

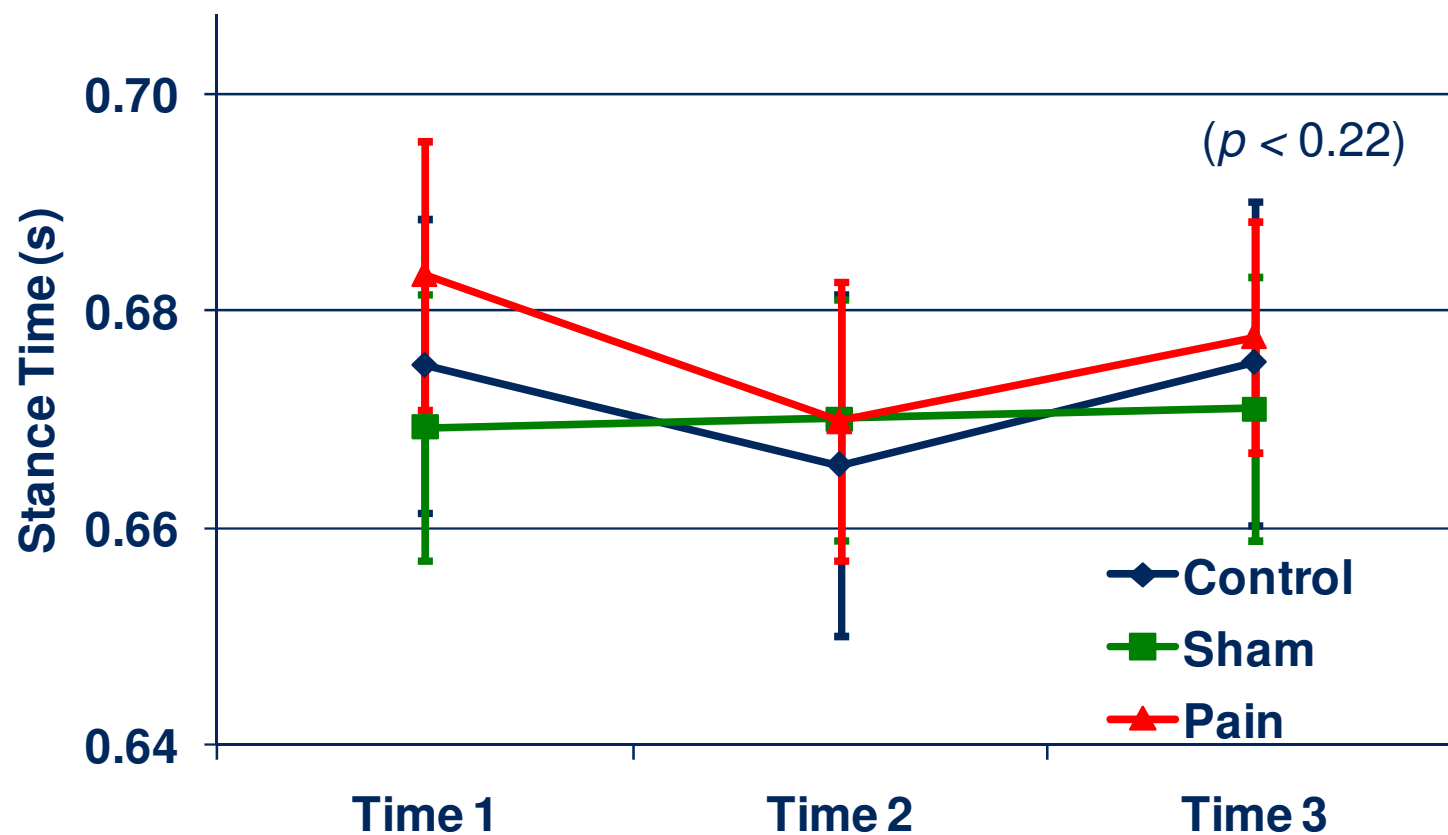


Experimentally-induced pain resulted in a decreased peak push-off GRF during Time 2



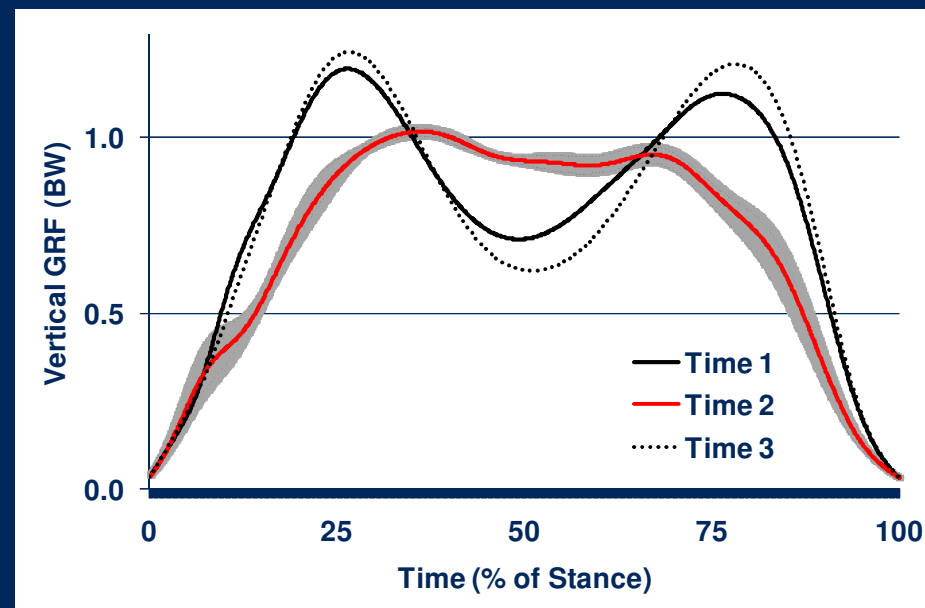
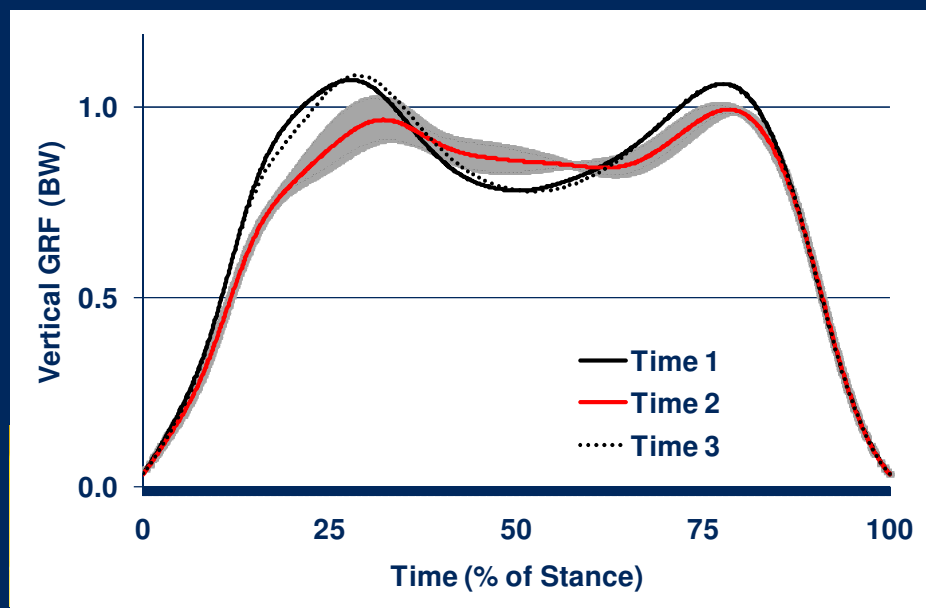
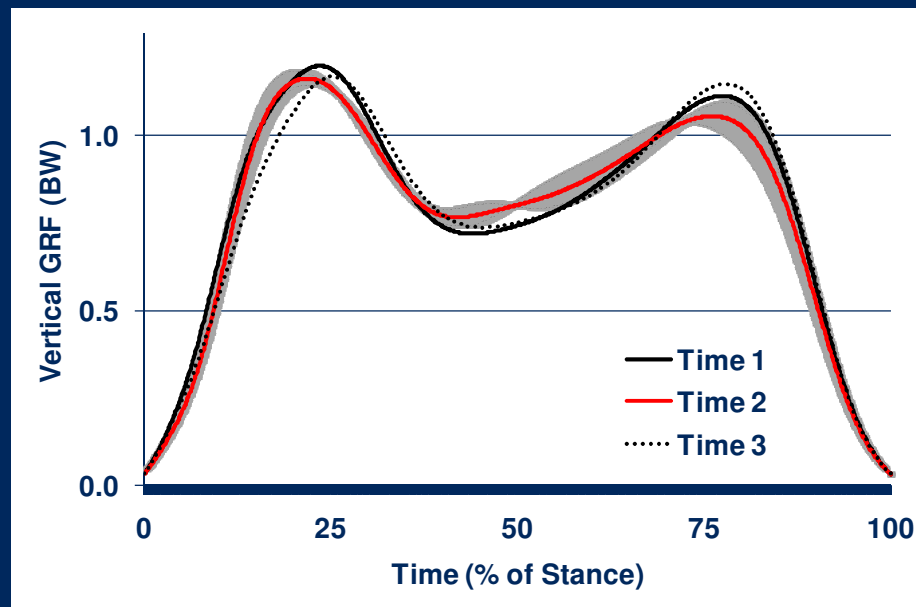
RESULTS

Stance time was not influenced by experimentally-induced pain



RESULTS

Effects of experimentally-induced anterior knee joint pain for three different subjects





DISCUSSION

- Generally, our hypotheses were not supported; most GRF characteristics were decreased as a result of the pain condition
- The experimental pain model did promote knee joint pain
- This may have been a result of a conscious or subconscious decision made by the subject to reduce GRF to the affected leg



DISCUSSION



- This observed emphasis to the unaffected leg may occur during other functional movements and increase GRF the unaffected leg
- This hypothesized increase in GRF to the unaffected leg may lead to increased injury/disease



