

Time Post-Anterior Cruciate Ligament Reconstruction Does Not Associate With The Capacity To Modify Walking Biomechanics

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BACKGROUND

Approximately half of individuals with an anterior cruciate ligament (ACL) injury and reconstruction (ACLR) develop radiographic post-traumatic osteoarthritis (PTOA) within two decades following injury.¹ Increased PTOA risk following ACLR is linked to both decreased quadriceps strength and aberrant walking biomechanics.² Further, these alterations in quadriceps strength and walking biomechanics change as time post-ACLR increases.^{3,4} Real-time gait biofeedback (RTGBF) which cues changes in vertical ground reaction force impact peaks (vGRF-IP) may be an effective way to elicit sustained gait improvements in ACLR individuals.⁵ However, it remains unknown if the amount of time post-ACLR would alter ACLR individuals' capacity to modify gait biomechanics and match given targets during a RTGBF intervention.

PURPOSE

The purpose of this study was to determine the association between time post-ACLR and individuals' capacity to adapt vGRF-IP in response to a vGRF-IP based RTGBF intervention. Specifically, we sought to evaluate the association between time post-ACLR and the root mean squared error (RMSE, described below) of vGRF-IP when using RTGBF to cue an increase of vGRF-IP by 5%, 10%, and 15%.

METHODS

Participants

- Thirty-five individuals 6 months - 5 years following primary unilateral ACLR (22 F, 21.4±4.0 years, 25.2±3.8 kg/m², 32.2±15.7 mo. post-ACLR)

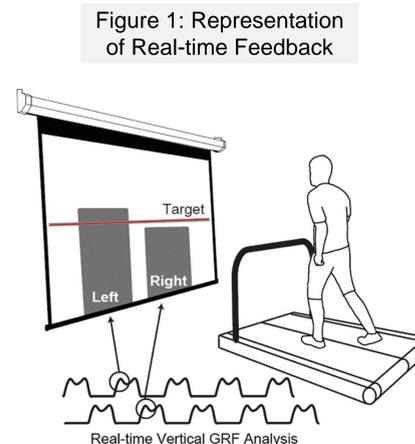
Real-time Gait Biofeedback Procedures for Walking Trials

- Participants' self-selected speed was determined.
- vGRF-IP was defined as the peak vGRF during the first half of stance phase (from initial contact (vGRF > 20 N) to toe-off (vGRF < 20 N)).
- vGRF data were collected on a dual-belt force measuring treadmill (Bertec, Columbus, OH).
- Individuals participated in a usual walking trial and three 250-step randomized walking trials with vGRF-IP based RTGBF intervention cueing increases in vGRF-IP of 5%, 10%, and 15%, respectively.
- Targets were calculated to be a 5%, 10%, or 15% force increase, respectively, of the average vGRF-IP during the usual walking trial.
- A screen directly in front of the treadmill displayed a horizontal line representing the target peak vGRF-IP as previously calculated for each experimental condition using a custom MATLAB code.

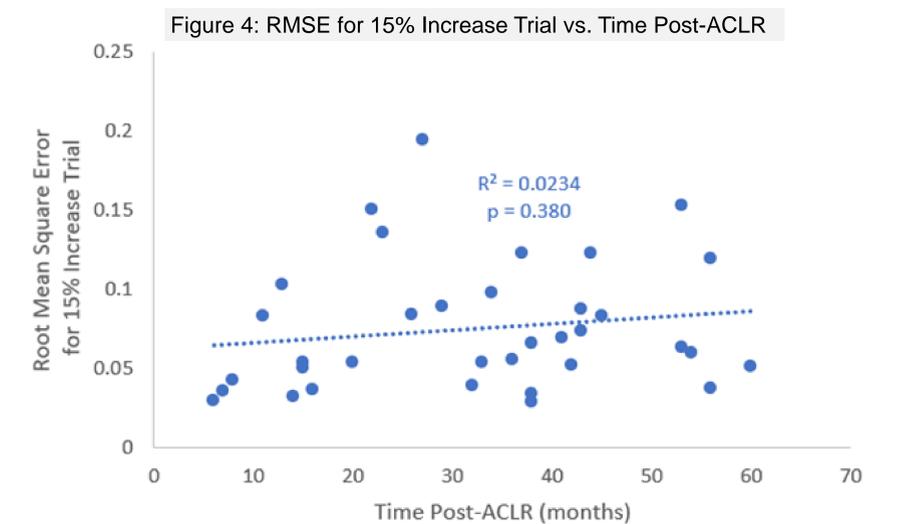
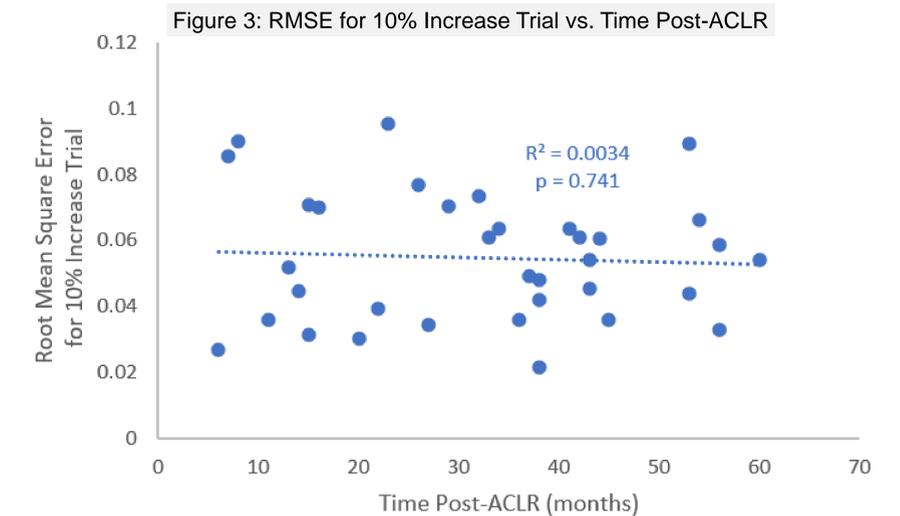
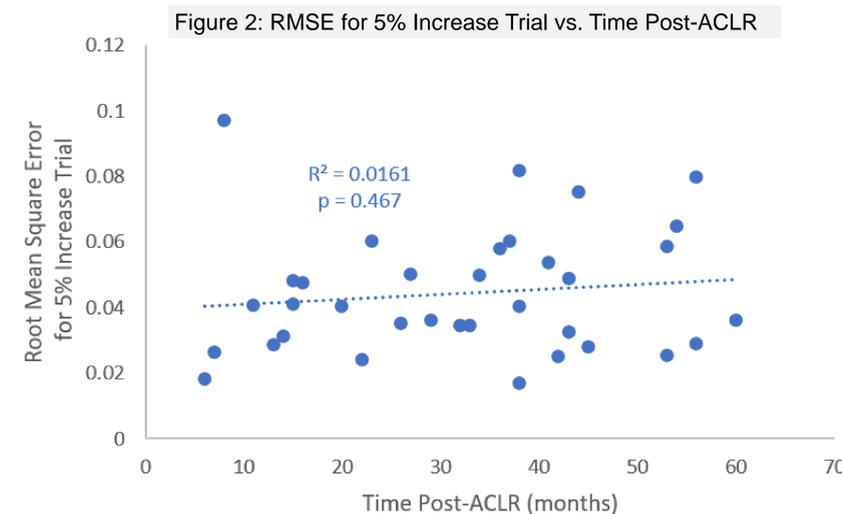
- Concurrently, the MATLAB code both calculated and displayed right and left bar graphs representing the continuously changing average of the previous two peak vGRF-IPs for each limb.
- Participants were instructed to attempt match their vertical bars to the target bars.

Statistical Analyses

- Individuals' capacity to meet the given cues was reported as root mean square error (RMSE), the square root of the sum of the squared residuals (target vGRF-IP – measured vGRF-IP of steps 230-240) divided by 10 for each trial.
- Three separate univariate linear regression analyses between time post-ACLR and RMSE for each RTGBF condition were conducted (time-post ACLR and RMSE for 5% Increase Trial, time-post ACLR and RMSE for 10% Increase Trial, time-post ACLR and RMSE for 15% Increase Trial).



RESULTS



- There were no significant associations between time post-ACLR and RMSE (5% RMSE: 0.048±0.023, 10% RMSE: 0.063±0.032, 15% RMSE: 0.071±0.038) for any of the 3 RTGBF trials (R² ranged between 0.003-0.023; all P values > 0.05).

CONCLUSION

- The capacity to adapt to biomechanics cued by RTGBF does not associate with time post-ACLR.
- These data suggest that RTGBF could be implemented between 6 months and 5 years post-ACLR with similar efficacy for eliciting immediate changes in gait biomechanics.

- References
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