

Neurofeedback Visualization Training Through a Brain Computer Interface to Optimize Muscle Activation Following Anterior Cruciate Ligament Reconstruction

Brian Forsythe MD, Catherine Hand BS, Camden Bohn BA, Josh Chang BS, Daanish Khazi-Syed BS, Jourdan Michael Cancienne MD, Jorge Chahla MD PhD, Shane Nho MD MS

BACKGROUND

- **Anterior Cruciate Ligament Reconstruction (ACLR)** is a common surgical intervention to restore knee stability after ligament rupture
- Postoperative patients frequently experience **muscle weakness** due to changes in motor cortex and corticospinal tract function.
- A key barrier to recovery is **arthrogenic muscle inhibition (AMI)** a neural phenomenon that prevents voluntary activation of affected muscle groups despite full structural healing.
- Standard rehabilitation may be limited in addressing these **neuroplastic changes**.
- **Neurofeedback Visualization Training (NFVT)**, via a non-invasive brain-computer interface (BCI), may help bypass this inhibition and promote motor reactivation.

PURPOSE

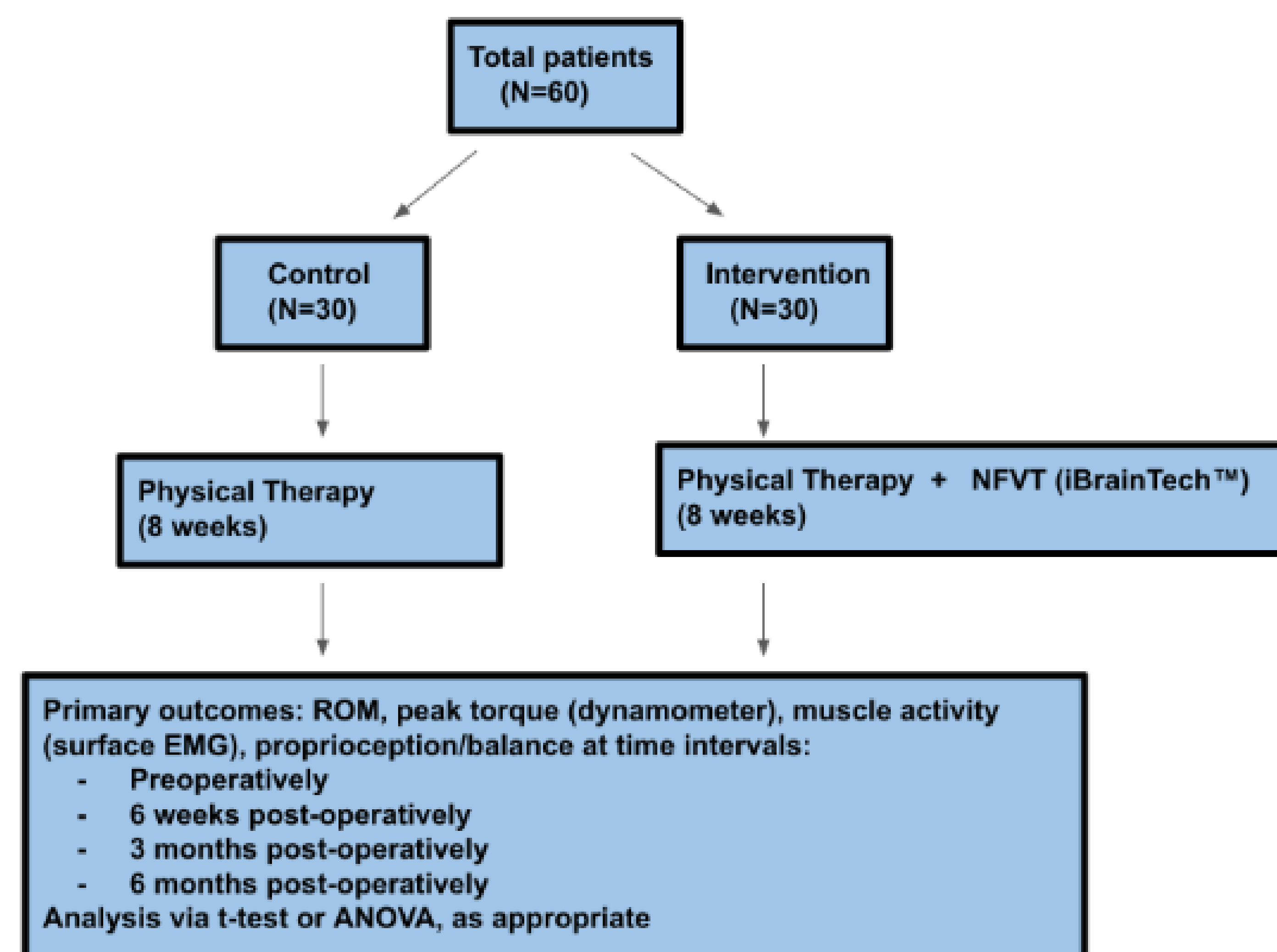
This study evaluates whether NFVT using BCI can improve muscle activation following ACLR.

Investigate the effects of NFVT on:

- ➔ Strength recovery
- ➔ Neuromuscular control
- ➔ Functional movement mechanics
- ➔ Determine if NFVT can accelerate rehabilitation and mitigate AMI in ACLR patients.

METHODS

- Study Design: IRB-approved, randomized, single-masked, controlled trial.
- NFVT protocol: EEG-based visualization of hip-focused rehab movements with real-time neurofeedback to activate the motor cortex.



RESULTS

- Patient enrollment commences April, 2025.
- Preliminary outcomes will be presented as patients reach postoperative milestones.
- Hypothesis: NFVT will result in:
 - ➔ Earlier recovery of muscle activation
 - ➔ Higher EMG activity
 - ➔ Greater strength restoration
 - ➔ Enhanced functional biomechanics

DISCUSSION

- ACLR patients often struggle with regaining neuromuscular control due to AMI.
- NFVT may serve as a breakthrough adjunct to traditional PT by retraining the brain-muscle connection.
- If effective, NFVT could:
 - ➔ Enhance rehab time
 - ➔ Improve long-term hip function
 - ➔ Reduce risk of compensatory movement patterns
 - ➔ Understanding and targeting AMI could transform postoperative protocols in hip preservation surgery.