The Brain has an ACL Problem

APTA Combined Sections Meeting
American Academy of Sports Physical Therapy
Friday, January 25, 2019: 3:00-5:00 PM
Washington D.C.

Speakers:
Terry L. Grindstaff, PhD, PT, ATC
Dustin Grooms, PhD, ATC, CSCS
Dan Lorenz, DPT, PT, ATC/L, CSCS

Course Description:
This session will focus on neurophysiological changes that occur following ACL reconstruction. Leading clinician scientists and researchers will discuss key elements of a comprehensive treatment approach from identification of neurophysiological changes in the research laboratory to application of addressing strength and motor control impairments in a real-world clinical practice environment. The session will conclude with audience questions and discussion with panel members.

Course Learning Objectives:
1. Apply current research to ACL rehabilitation clinical cases.
2. Recognize clinical signs of neurophysiological changes following ACL reconstruction
3. Observe a clinical decision-making model to inform treatment selection to address impairments in sensorimotor control, muscle strength, and athletic performance following ACL reconstruction.

Session Outline:
00:00-00:05 Introduction and overview of session format
00:05-00:25 Neuromuscular effects of ACL injury- Peripheral changes (Grindstaff)
00:25-00:50 Neuromuscular effects of ACL injury- Central changes (Grooms)
00:50-01:20 Treatment overview (Lorenz)
01:20-01:45 Clinical cases (Grooms, Grindstaff, Lorenz)
01:45–02:00 Moderator-led Q&A/summary of session (Grindstaff)
Neuromuscular effects of ACL injury - Peripheral changes (Grindstaff)

Despite surgical intervention and rehabilitation 30-50% of individuals continue to have impairments and decreased function at return to sport
- 20-30% have reinjury within 2 years

Quadriceps weakness
- Common impairment after knee joint injury
- Most severe immediately following injury or surgery
- Can persist beyond 15-20 years after injury

Quadriceps weakness causes (Ingersoll et al, 2008; Rice and McNair 2010; Pietrosimone et al, 2012).
- Peripheral (muscle atrophy) (Kuenze et al, 2016; Norte et al, 2018)
- Neurological (a.k.a. quadriceps inhibition) (Hart et al, 2010; Ingersoll et al, 2008; Lepley et al, 2015)
  - Spinal reflex excitability (more acute response) (Harkey et al, 2016)

Peak torque vs rate of torque development (Grindstaff et al, In Review)
- RTD diminished to greater degree
- Correlates with function
Neuromuscular effects of ACL injury - Central changes (Grooms)

Limitations of Biomechanical Model for ACL Rehabilitation (Ageberg et al, 2008; Benjaminse et al, 2011; Diekfuss et al, 2018)
- Noncontact nature of injury
- Second (re-injury) rate
- Strength vs. Motor recovery

Motor Control and Neuroplasticity (Alahyane et al, 2008; Brown and Teskey 2014)
- Measuring the CNS
- How the brain generates movement

Cascade of Neuroplasticity after ACL injury (Kapreli et al, 2006; Ward et al, 2015)
- Theoretical sequence of deafferentation and motor compensation

Neuroimaging Neuroplasticity (Grooms et al, 2017; Kapreli et al, 2009; Lepley et al, 2015)
- Using fMRI to capture neural activity and structural differences
- Other neuroscience modalities
  - EEG
  - TMS

Clinical Implications (Grooms et al, 2018; Kim et al, 2017; Rausch et al, 2018)
- Targeting specific neuroplasticity
  - Sensory reweighting
  - Visual-motor reliance
  - Pain processing
  - Motor drive
Treatment overview (Lorenz)

I. Introduction
   a. To maximize quad activation:
      i. Reduce swelling
      ii. Maximize extension ROM
         1. 3-5° loss of extension affects subjective outcomes (Shelbourne et al, AJSM 2009)
         2. Infrapatellar Contracture Syndrome (Paulos et al, AJSM 1987)
      iii. Initiate and sustain a quad contraction
      iv. Early WB (Tyler et al, 1998)

II. Strengthening Phases
   a. Eccentrics (Gerber et al, 2006; 2007;2009)
   b. OKC knee extension (Fukuda et al, AJSM 2013; Perry et al, KSSTA 2005; Tagesson et al, AJSM 2008)

III. Perturbation Training

IV. Visual Re-training
   a. VR apps/Google Cardboard
References:


Rausch M, Simon JE, Starkey C, Grooms DR. Smartphone virtual reality to increase clinical balance assessment responsiveness. *Phys Ther Sport*. 2018;0(0). doi:10.1016/j.ptsp.2018.05.017


