Can Fear or Other Psychological Factors Alter Movement After ACL Reconstruction?

CSM 2019 Educational Session – Research Section

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A. Theoretical framework linking psychological responses and movement after ACL reconstruction
   1. Fear of re-injury, elevated kinesiophobia, and low self-efficacy (confidence) are common psychological responses to sports injury, including ACL reconstruction
      Tracey J. J Appl Sports Psych 2003
      Chmielewski TL et al. Phys Ther 2011
      Clement D et al. JAT 2015
   2. These psychological responses show associations with many rehabilitation outcomes after ACL reconstruction
      a. Fear of re-injury is associated with not returning to sport after ACL reconstruction
         Lentz TA et al. JOSPT 2012
      b. Elevated kinesiophobia is associated with poorer knee function, poorer knee impairment resolution, not returning to sport, and possibly re-injury after ACL reconstruction
         Kvist J. KSSTA 2005
         Chmielewski TL et al. JOSPT 2008
         Cozzi AL et al. J Sport Rehabil 2015
         Chmielewski TL and George SZ. KSSTA 2018
         Paterno M. Sports Health 2018
      c. Higher self-efficacy/confidence for future knee function is associated with return to sport after ACL reconstruction
         Senorski EH et al. KSSTA 2017
   3. These psychological responses have also shown associations with motor/movement outcomes in other populations
      a. High fear/anxiety alters postural control in those with fall risk
         Young WR and Williams AM. Gait Posture 2015
         Adkin AL. Front Neurosci 2018
      b. Fear of falling reduces spatial and temporal parameters of gait in older adults
         Makino K. Geriatr Gerontol Int 2017
      c. Elevated kinesiophobia reduces muscle strength output after experimental back pain
         Trost Z. Pain 2011
      d. Elevated kinesiophobia reduces range of movement in experimental pain models
         Thomas JS. Spine 2007
         Trost Z. Pain 2012
B. Do altered psychological factors contribute to altered movement patterns after ACL reconstruction (low demand tasks)?

1. Why do we care about gait?
   i. Evaluate and start intervening early after surgery
   ii. Link between gait mechanics and development of knee OA (Wellsandt, 2015; Tichenal, 2018)

2. Asymmetries in gait after ACLR
   i. Early after ACLR impairments are present
      1. Loss of extension ROM, effusion, pain
      2. Quadriceps dysfunction
         a. Quadriceps dysfunction is associate with aberrant walking biomechanics (Lewek, 2002; Snyder-Mackler, 1995; Blackburn, 2016b)
         b. Regaining symmetrical quadriceps strength does not guarantee symmetrical gait (Roewer, 2011)
   ii. Persistent gait alterations are common for up to 2 years or more
      1. Common kinematic findings (Kaur, 2016; Slater, 2017)
         a. Reduced peak knee flexion compared to contralateral limb and controls
         b. Reduced knee flexion excursion
      2. Common kinetic findings (Kaur, 2016; Slater, 2017)
         a. Reduced external knee flexion moments compared to contralateral limb and controls
            i. Indicative of under loading the knee joint (Andriacchi, 1990)
         b. Reduced peak knee adduction moment compared to contralateral limb and controls

3. My experience with psychological factors and biomechanics
   i. ACL-SPORTS program/RCT
      1. Anecdotal examples
         a. Patient case with video

4. Relationship between psychological factors and gait asymmetries
   i. Conflicting research
      1. There is a weak relationship between knee kinematic asymmetries and psychological readiness to return to sport (Zarzycki, 2018)
      2. NO relationship between multiple gait parameters and kinesiophobia (Luc-Harkey, 2018)
   ii. Study differences
1. TM vs over ground walking
2. Psychological measures (TSK-11 vs ACL-RSI)
3. Mean time from surgery (mean 49 months vs 5.5 months)

5. Clinical Take Away for low-demand tasks
   1. May be a relationship between psychological factors and walking biomechanics
      a. Must consider:
         i. Measure being used
         ii. Time from surgery
      b. Likely a subpopulation of athletes with low confidence and high fear that would benefit from targeted gait interventions prior to return to sport.
      c. However, restoring full ROM, resolution of pain, and regaining adequate quadriceps strength is necessary is imperative

C. Do altered psychological factors contribute to altered movement patterns after ACL reconstruction (high demand tasks)?
   1. Athletes engage in physically demanding tasks beyond walking
      i. Jumping and hopping tasks are used to develop readiness for sports participation (Adams 2012, Wilk 2013, Elias 2018)
      ii. Jump landing is when many non-contact ACL injuries occur
   2. Comparing Physical Demands between walking and jumping/hopping tasks
      i. Walking is the most common daily mobility activity but the internal knee extensor moment during self-paced walking is generally less than a third of the moment observed during jumping tasks (Hart 2010, Johnston 2018)
      ii. Single leg tasks associate with less knee flexion whereas bilateral tasks have greater flexion and less ground reaction force and sagittal joint moments
   3. Common Aberrant Movement Patterns During Jump and Hop tasks following ACL surgery
      i. Single leg landings: Athletes show restricted knee flexion during weight acceptance with a limited knee extension moment that presents early and persists over time
      ii. Two legged landings are characterized by unweighting the operated leg with less knee extension moment than uninjured peers
      iii. Implications: generally these movement behaviors are undesirable
         1. Eg. Stiff jump landing patterns with limited knee extension moment suggests an increased risk for second non-contact ACL injury
   4. Early Evidence Suggests Psychological Factors Relate to Aberrant Jump Performance
      i. Patients with more psychological distress tend to reduce their hop distance and show greater asymmetry for hop distance (Lee 2018)
      iii. Athletes with less confidence and more fear of reinjury tend to have greater asymmetry of knee extensor moment and limb load during drop vertical jump (Mizner RL 2018)
   5. Summary and Clinical Implications
      i. Answer to our clinical question is... Yes, altered psychological factors can contribute to altered movement patterns in both quantitative and qualitative ways
ii. Tasks selection during an assessment could impact on this relationship
   1. As tasks demands increase so does the relationship between psychological measures and undesirable movement responses
   2. Advance stages of ACL rehab, when jumping and hopping are introduced, may be a critical time to consider psychological factors in patient care

iii. Psychologically mediated aberrant movement patterns will likely shape risk factors for 2nd knee injury when returning to sport after injury
   1. Psychological Factors may not have a direct linear relationship with injury risk (Paterno M 2018). For instance, a confident and fearless athlete may have increased risk for a 2nd injury with RTS in some circumstances

6. Discussion and Food for thought
   i. These findings need context amongst other clinical measures (ROM, strength, pain)
      1. More than just psychological factors at play in correlation with movement performance during jump landing (Schmitt LC, Paterno M 2011-2018)
         a. Example: Muscle strength is associated with altered movement patterns and patients’ outcome
   ii. Relationship between psychological factors and movement patterns is complex
      a. Sparse evidence available currently and our understanding could dramatically change as more work is published

D. Screening and Intervention for Psych Factors to Improve Movement
   1. “Psychologically informed practice”
      i. Incorporation of patient beliefs, attitudes, emotional responses into patient management based on biopsychosocial model (Main and George, PTJ, 2011)
      ii. Based on fear avoidance model: treat current symptoms, but prevent development of unnecessary (pain related) activity limitations
   2. Methods to Screen psychological responses
      i. Different psychological constructs require different questionnaires
         1. Overall Psychological Readiness – ACL-RSI (Webster KE, Phys Ther Sport, 2008)
         2. Kinesiophobia/Fear of reinjury – TSK-11, ; PHOSA-ACLR (Van Lankveld, BMC Muscu Disor 2017))
      ii. Who?
         1. Demographic variables associated with better psych readiness (Webster, AJSM, 2018)
      iii. When?
         1. Kinesiophobia likely needs to be addressed earlier in rehab (Chmielewski, KSSTA, 2018)
         2. Periodic re-evaluations throughout rehab and especially at RTS period
   3. Interventions to address psych factors that may underlie movement
      i. Exercise based interventions
         1. Graded exercise vs graded exposure
         2. Plyometrics (Chmielewski, AJSM, 2016, Meierbachtol, JOSPT, 2018)
      ii. Non exercise based interventions

4. Final points
   i. Variety of questionnaires, depending on desired psychological construct, that are available and can be used throughout rehab course
   ii. Intervention work is ongoing – this may need to be individualized