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Examining Movement Function in Patients with Knee Osteoarthritis

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Biomechanical Gait Analysis for Improving Clinical Outcomes: Applications for Orthopedics, Geriatrics and Community Based Research

UMCCTS Research Retreat
Mini Symposium

Katherine Boyer, PhD
Assistant Professor
Department of Kinesiology
Memorial gait analysis clinic

- Partnership between UMMS Orthopedics and UMass-Amherst Kinesiology

- Memorial gait analysis clinic- 1st floor North wing Memorial
Memorial gait analysis clinic

- The goal of this new facility
  - is to foster and support across campus collaborations
  - to incorporate biomechanical testing and monitoring of joint mechanics into the standard clinical care
  - development of new monitoring devices as part of the UMass-Amherst Center for Personal Health Monitoring in the Institute of Applied Life Sciences.
Mini symposium

1. PROs in TJR Clinics - Surrogate for Measures of Activity? Dr. Franklin

2. Measures of Activity/Mobility in TJR Practice - Where Are We Now? Dr. Ayers

3. Examining Movement Function in Patients with Knee Osteoarthritis. Prof. Boyer

4. Increasing Physical Activity Amounts and Intensity in Older Adults Using Low Cost Wearable Devices - "Cadence Training". Prof. Tudor-Locke
Examining Movement Function in Patients with Knee Osteoarthritis

Katherine A. Boyer
2016
Disclosure Slide

- I have no actual or potential conflict of interest in relation to this program/presentation
Patient reported outcomes

Key constructs
• Mobility
• Physical Function
• Pain and Stiffness

Methods
• Short Form 12 or 36
• Knee or Hip OA Outcomes Scores (KOOS, HOOS)
• Visual Analog Pain Scales

Patient perception of abilities and disease severity
Musculoskeletal and Orthopedic Biomechanics Laboratory

Adapted from Andriacchi et al., 2004

Gait mechanics

Force and motion at joint surface

Tissue/Cell mechanobiology

Joint mechanics

Human Movement

Tissue level strains and morphology

Physical function

Physical activity pattern

Pain severity
What is gait analysis
What is gait analysis?

- Force platform
- High speed
- Infrared camera
Gait outcomes in walking - Knee

Vert. Ground Rxn force

Knee Flexion moment

Knee Adduction moment

Knee Flexion Angle [deg]

Knee extensor function

Compressive load distribution

Load distribution
Gait mechanics

Force and motion at joint surface

Tissue/Cell mechanobiology

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Physical function

Adapted from Andriacchi et al., 2004
Knee angle at heel-strike → Location of thickest cartilage
(Koo et al., 2011, Scanlan et al., 2013)
Gait and cartilage morphology

**Medial/Lateral Thickness vs. Adduction Moment**

Andriacchi et al., *Annals of Biomedical Engineering*, 2004

R² = 0.51

R² = 0.73
Gait mechanics

Tissue/Cell mechanobiology

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Human Movement

Adapted from Andriacchi et al., 2004
Gait and OA exercise induced pain

- Exercise recommended for OA management
  McAlindon et al. 2014 OARSI guidelines *Osteoarthritis Cartilage*

- Acute exercise exacerbates pain in OA on a short term basis Fotch et al., 2002, Sandal et al., 2015.

- Are there gait characteristics that contribute to greater pain flares with weight bearing exercise?
Gait and exercise induced pain

- Participants
  - 15 healthy older adults (50 – 75 years)
  - 15 symptomatic knee OA

- Exercise protocol for flare

  20 min treadmill walk

  40 min seated rest

  20 min “fitness pace” treadmill walk

- Pain reported - Verbal numeric rating scale
Gait and exercise induced pain

- 8 OA participants – clinically significant pain increase ≥ 2pts
- 7 OA participants – non-responders to exercise flare

![Pain flare with exercise graph]

![Age and Koos pain graphs]

Boyer et al., in prep
Gait and exercise induced pain

Magnitude of load on the knee joint in walking influences the pain flare

Boyer et al., in prep
Gait mechanics

- Force and motion at joint surface
- Tissue/Cell mechanobiology
- Joint mechanics
- Tissue level strains and morphology
- Human Movement
- Pain severity
- Physical function
- Physical activity pattern

Adapted from Andriacchi et al., 2004
Acknowledgments

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