Simultaneous Measurement of Muscle Activity, Kinetics, and Pain in Women with Carpometacarpal Osteoarthritis

Tamara Ordonez Diaz¹, Samuel Licht¹, Kevin A. Hao², Yenisel Cruz-Almeida³, and Jennifer A. Nichols¹
J. Crayton Pruitt Family Department of Biomedical Engineering¹, College of Medicine², and College of Dentistry³, University of Florida

BACKGROUND

Carpometacarpal osteoarthritis (CMC OA) affects 85% of postmenopausal women [1], and leads to [2]:
• Severe pain
• Decreased strength
• Decreased range of motion

Objective: Examine the relationship between movement and pain by simultaneously measuring pinch force, muscle activity, and movement-evoked pain in individuals with CMC OA and healthy older adults.

Hypotheses: Compared to healthy age-matched adults, participants with CMC OA would
(1) generate lower forces,
(2) activate extrinsic muscles more than intrinsic muscles,
(3) have higher movement-evoked pain.

MATERIALS AND METHODS

Subject Recruitment:
• 5 participants diagnosed with CMC OA
  • Female: age 70.8 ± 8.4 years
  • 5 healthy older adults
  • Female: age 68.2 ± 12.0 years

Tasks:
• Isometric Force
  • Force was collected before- and after- EMG insertions.
  • All tasks were completed 3 times with at least 10 s rest between trials.
  • For each task participants were asked to complete:
    • 3 s MVC’s
    • 5 s 50% suboptimal force

  • Movement-Evoked Pain (MEP)
  • All participants were instructed on how to use the 101-point visual analog scale (VAS).
  • Pain ratings were obtained:
    • before- and after- EMG insertions and
    • before-, during-, and after- each task

Fine-Wire Electromyography (f-EMG)
• Muscle activity was collected from 4 extrinsic and 4 intrinsic thumb muscles.
• All f-EMG was performed by 1 experimenter and insertions were ultrasound guided.

 Isometric Force

Movement-Evoked Pain (MEP)

RESULTS

Results from this study highlight the need to perform patient-specific analysis to understand the extent to which different levels of force exertion and muscle activity uniquely impact the experience of pain.

Despite CMC OA participants having increased sensitivity to pain, their force data suggest that they have learned to push through the pain and/or compensate to accomplish tasks.

Whether CMC OA participants have found an optimal muscle activation pattern to avoid pain or protect the joint is still unknown.

SIGNIFICANCE

Understanding the interplay of biomechanics and pain can:
• Inform and improve targeted treatment to restore full joint mobility and eliminate pain.

The heterogeneity of muscle activation patterns during task

CMC OA participants generated similar forces as healthy older adults before fEMG with a trend toward greater forces after fEMG.

CMC OA participant deactivates some of their intrinsic muscles during task

Healthy adults had a decrease of force production in the palmar direction after fEMG.