Comparison of Experimental Pain and Functional Impact in Individuals with Single- and Multi-Site Osteoarthritis

Tamara Ordonez Diaz[1], Roger Fillingim[2], Yenisel Cruz-Almeida[2], and Jennifer A. Nichols[1]

J. Crayton Pruitt Family Department of Biomedical Engineering[1], and College of Dentistry[3], University of Florida

BACKGROUND

Osteoarthritis (OA) is the **most common** joint disorder in the United States, affecting **over 32.5 million** US adults.[1,2]

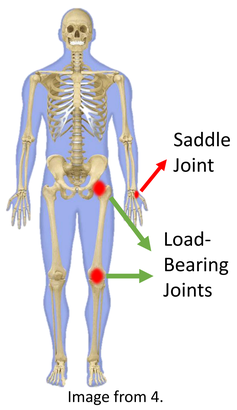


Image from 4.

Most common sites include:
- Knees
- Hips
- Hands

Multi-site OA, or OA at 2 or more joints, can lead to poorer outcomes and increased disease progression.[3]

Limited research has been done on the smaller non-load-bearing joints of the hand and their impact on osteoarthritic pain.

Motivation: Limited understanding whether individuals with multi-site OA exhibit altered pain processing and psychosocial function compared to those with single-site OA.

Hypotheses: Individuals with multi-site OA have significantly higher experimental pain and decreased function than individuals with single-site OA or no OA.

MATERIALS AND METHODS

Study Design:
Secondary data analysis from community-dwelling individuals from UPLOAD1 and UPLOAD2 (*IRB# 201400209, IRB# 201500906)*

Inclusion
- Clinically diagnosed knee OA

Exclusion
- Surgery (e.g., joint replacement)
- Systematic rheumatoid arthritis
- Peripheral neuropathy
- Cognitive impairment
- Daily opioid use

Total sample size
N = 1,260

CMC Pain Cohort
- Right and/or left-hand CMC joint pain
  - *Exclusion*: knee pain

Knee Pain Cohort
- Right and/or left knee pain
  - *Exclusion*: CMC pain or pain at any other hand joint

CMC + Knee Pain Cohort
- Both CMC and knee pain reported

No Pain Cohort
- Scored 0 on the WOMAC-pain and GCPS
- Number of pain sites reported ≤3

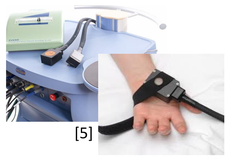
Quantitative Sensory Testing:

Mechanical
- Pressure pain threshold: applied at a constant rate (30 kPa/s) until sensation first becomes painful

Thermal
- Heat pain threshold and heat pain tolerance: temperature increased at a rate of 0.5°C/s

Temporal Summation (TS)
- *TS of heat pain:* series of 5 brief and repetitive health pulses at 3 different temperatures
- *TS of punctuate pain:* pain reported after 10 consecutive trials using a calibrated Von Frey monofilaments (300 g)


[5]


[5] [6]


[7]

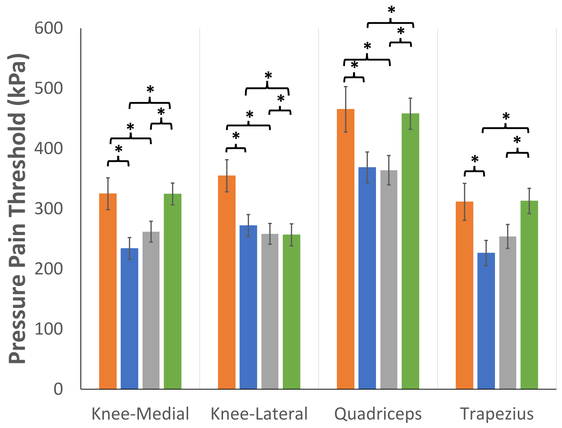
Clinical Pain and Functional Assessments
- Graded Chronic Pain Scale (GCPS)
- Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)
- Coping Strategies Questionnaires (CSQ)
- Revised Life Orientation Test (LOT-R)
- Positive and Negative Affect (PANAS)

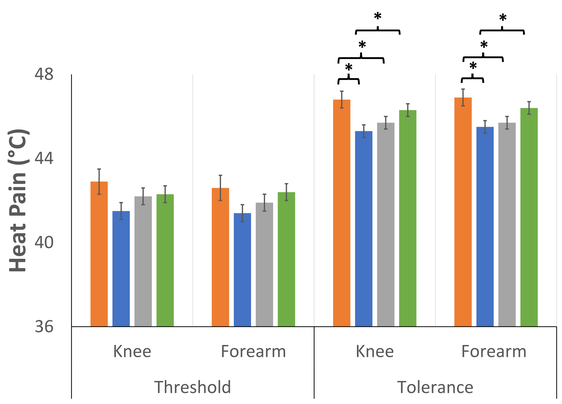
	CMC Pain (n=36)	Knee Pain (n=74)	CMC + Knee Pain (n=87)	No Pain (n=73)	P-value
Age, mean ± SD	59.92 ± 6.97	55.80 ± 6.92	57.98 ± 7.61	57.49 ± 8.88	0.373
Race, % (Count)					0.562
African American	44.4 (16)	52.7 (39)	49.4 (43)	41.1 (30)	
Non-Hispanic white	55.6 (20)	47.3 (35)	50.6 (44)	57.5 (42)	
Other				1.4 (1)	
Sex, % (Count)					0.047
Female	72.2 (26)	62.2 (46)	79.3 (69)	61.6 (45)	
Male	27.8 (10)	37.8 (28)	20.7 (18)	38.4 (28)	

Statistical Methods:
ANCOVA was performed to assess the difference across single- and multi-site OA. Adjusted model included sex as a covariate.

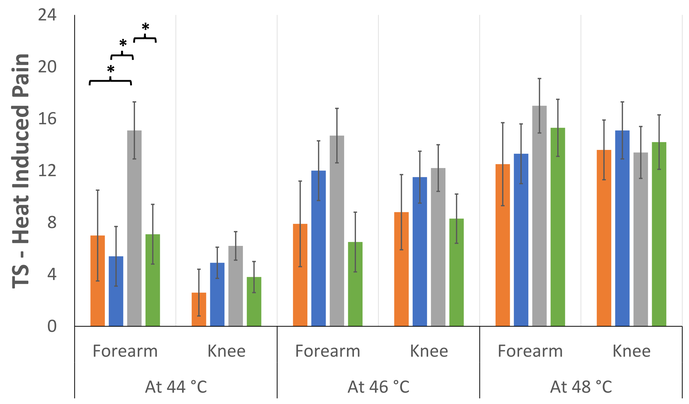
RESULTS

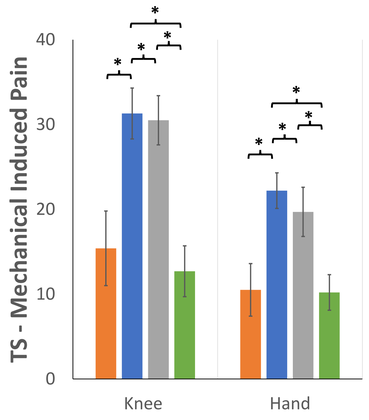
Quantitative Sensory Testing





- Significant differences were observed across the CMC + Knee pain cohort and the CMC pain cohort. The CMC pain cohort had the highest pressure pain threshold, heat pain thresholds and heat tolerance.





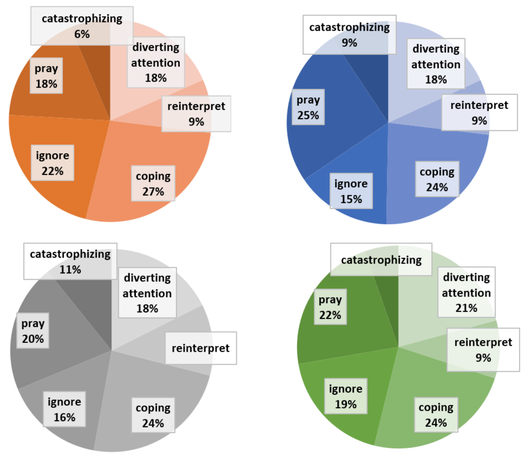
- CMC + Knee pain cohort had significantly higher pain during temporal summation (p=0.01) compared to CMC pain and Knee pain cohort.
- CMC + Knee pain cohort was also consistently highest across most temperatures and sites.
- CMC + Knee pain was significantly different with CMC pain but not Knee pain cohort.
- Knee pain cohort had significantly higher pain during mechanical TS in comparison to CMC pain cohort (p<0.01).

Clinical Pain and Functional Assessments

Estimated Marginal Means (SE)	CMC Pain	Knee Pain	CMC + Knee Pain	No Pain
GCPS				
Pain intensity	35.5 ± 3.4	56.2 2.3	61.0 2.2	0.0 ± 2.3
Disability	29.0 ± 4.4	45.0 ± 3.0	54.2 ± 2.8	0.0 ± 2.9
WOMAC				
Pain	4.4 ± 0.6	7.9 ± 0.4	9.0 ± 0.4	0.0 ± 0.4
Stiffness	2.1 ± 0.3	3.5 ± 0.2	4.1 ± 0.2	0.1 ± 0.2
Function	13.5 ± 2.1	25.0 ± 1.5	29.4 ± 1.3	0.2 ± 1.5

- CMC + Knee pain cohort had the highest self-reported pain, disability, and emotional distress.

Coping Strategies



- CMC + Knee pain cohort coped through reinterpreting their pain (p<0.01) and catastrophizing (p<0.01) more often than single-site OA cohorts

DISCUSSION

Individuals with multi-site OA had the **lowest pain thresholds** and **highest self perceived functional disability** in comparison to individuals with single-site OA.

Hand OA has been found to commonly be diagnosed in conjunction with knee OA[5,6], yet no study to our knowledge has compared CMC to knee pain phenotypes.

Differences between CMC pain and Knee pain cohort suggest the way CMC OA affects the central nervous system and leads to enhanced widespread pain sensitivity should be further examined.

Results from the clinical and functional questionnaires highlight the disease and pain severity is more severe when other types of pain or OA are compounded with CMC OA.

Future studies can isolate individuals with only clinically diagnosed CMC OA and quantify their experience thoroughly (e.g., assessing pain thresholds at the CMC joint).

Expanding research of smaller joints could inform and improve treatment options which are lacking in comparison to larger joints.

ACKNOWLEDGEMENTS

Funding from the National Institutes of Health (KL2 TR001429) and from the University of Florida Graduate Preeminence Award is acknowledged.

REFERENCES: [1] Osteoarthritis *CDC* [2] Zhang et al. 2015 *Clin Geriatr Med* 26(3):355-69 [3] Nelson et al. 2014 *Semin arthritis Rheum* 43(6):713-20 [4] https://www.pngwing.com/ [5] https://www.medoc-web.com/algomed [6] Bosch et al. 2017 *BMC Pediatrics* [7] https://www.danmicglobal.com/514000-20c.aspx