QUANTITATIVE PROPRIORCEPTION IN YOUNG ADULTS

Student Researchers:
Skeeter Welder, Serena Vonkchalee

Faculty Advisors:
Jason R. Wingert, PhD, MPT, Patrick Foo, PhD

University of North Carolina at Asheville

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INTRODUCTION TO THE RESEARCH

▶ What is Proprioception?
▶ Why is Proprioception important to study?
▶ Main Goals of Research-
  ▶ Provide a quantitative picture of what happens to proprioception across the lifespan
  ▶ Develop strategies for fall prevention in older adults
▶ Current Study and Results
▶ Future Directions
WHAT IS PROPRIOCEPTION?

- A complex somatosensory modality that utilizes inputs from skeletal muscle, skin afferent fibers, and joint capsules
- Informs us of:
  - The degree to which our muscles are being contracted
  - The amount of tension created in the tendons
  - Change in position of a joint
WHY STUDY PROPRIOCEPTION?

It may lead to the prevention of falls
ROLE OF PROPRIOCEPTION IN FALL PREVENTION

- Reduced proprioception = a possible cause of instability or falls
- Quantitative measurement of proprioception required to expose an association between reduced peripheral sensation and balance defects
- Clinical relevance of understanding the role of proprioception in age-related balance disorders
  - Poor balance is one of the major risk factors for falls among the elderly
  - 1/3 of 65+ experience at least one fall per year
  - Improve quality of life by increasing awareness of one's balance strengths/limitations

Piirtola, Maarit, Force Platform Measurements as Predictors of Falls among older People- A Review, 2006
ROLE OF PROPRIOCEPTIVE FEEDBACK IN VOLUNTARY MOVEMENT

- Affects the degree of movement accuracy
- Sustains constant muscle force/movement
- Coordinates gait patterns, body and limb segments to self and environment
- Critical source of sensory feedback for standing balance
ROLE OF PROPRIOECEPTION IN BALANCE

“Proprioception input from the lower limbs is arguably the most important contributor to standing balance”

WHAT HAPPENS TO PROPRIOCEPTION ACROSS THE LIFESPAN?

Age Related Decline is seen in multiple functions:
- 5 Senses
- Vestibular Sense
- Sensory Integration
- Reaction Time
- Muscle Strength

...but what happens to proprioception?
CLINICAL ASSESSMENT OF BALANCE

- Approach determines underlying sensorimotor mechanisms [proprioception] contributing to balance disorders
- 3 main approaches:
  - Quantitative assessments
  - Functional assessments
  - System/Physiological assessment
- Differentiates different kinds of balance disorders
- Assesses fall risk

Mancini, M. *Relevance of Clinical Balance Assessment Tools to Differentiate Balance Deficits*, 2010
QUANTIFICATION OF PROPRIOCEPTION ACROSS THE LIFESPAN

- Our study aims to answer the question: Does proprioception decline across the lifespan and how does this potential loss of sensory information relate clinically to overall balance and fall risk?

- Our research seeks to link age-related changes in quantitative hip proprioception to:
  - To measurements of sway
  - To number of falls in past 12 m
  - To the fear of falling
  - To dynamic balance test
QUANTITATIVE PROPRIOCEPTION IN YOUNG ADULTS

- Participant Data
- Methods
- Results
- Future Research
PARTICIPANT DATA

- Participants: 44 total
  - 20 Young Adults, Mean Age: 20 years
  - 18 Mid- Aged Adults, Mean Age: 52 years
  - 6 Older Adults, Mean Age: 74 years
- All recruited from the UNC- Asheville community
- All met exclusion criteria
MEASURING PROPRIOCEPTION

- Proprioception consists of two main components:
  - Joint Position Sense
  - Kinesthesia
- Custom-built device allows for rotation around the axis of a semi-goniometer to measure joint position sense and kinesthesia at the hip
Joint Position Sense

- Hip joint proprioception was measured in the transverse plane.
- Participants actively pointed their second toe to 10 target angles randomly selected during two conditions,
  - (1) a *vision* condition
  - (2) a *no vision* condition
- The magnitude of error between performance and target location were recorded to the nearest degree.
- These two vision conditions were compared across participants' gender and side of limb dominance.
KINESTHESIA

- Hip joint kinesthesia was measured in the transverse plane, with obscured vision for all trials.
- Participants immediately reported the sensed movement direction of passive rotation of the lower limb.
  - Experimenter used control rod attached to the back of the semi-goniometer.
  - 10 trials in which direction was pseudorandomly selected:
    - 5 moving internally, 5 externally.
  - Passive rotation was approximately 0.5 degrees/second with a maximum displacement of 4 degrees.
RESULTS- YOUNG ADULTS JOINT POSITION SENSE AND KINESTHESIA

- Proprioception error in JPS was significantly higher during the no vision trials compared to the vision trials for both the dominant and non-dominant legs.
- No differences in JPS error between dominant and non-dominant legs
- No significant difference (p=0.75) in kinesthesia between dominant and non-dominant legs

* < 0.01
D = Dominant Leg
ND = Non-Dominant Leg
RESULTS- ACROSS THE LIFESPAN
JOINT POSITION SENSE AND KINESTHESIA

Significant reduction in proprioception (JPS and Kinesthesia) in older versus young adults

YDom (mean: 3.550+/-0.3464) vs.
ODom (mean: 6.100+/-1.006),
P=0.0053.

YDom (mean: 93.00%+/-2.911) vs.
ODom (mean: 68.33%+/-11.95)
P=0.0076.
SUMMARY/ FURTHER RESEARCH

- Found significant reduction in proprioception with older versus young adults (JPS, $p=0.0053$; Kinesthesia, $p=0.0076$),
  - Activity level may prove to be a protective factor
- Compare results of YA/ MA/ OA for JPS, Kinesthesia to a complete analysis on data from miniBESTest, Force Platform, and Mindfulness Position in all age groups
- Further investigation will determine:
  - If changes in proprioception during aging contribute to decreased balance and therefore, increase the risk of falling

Participate in the ongoing research at UNCA’s Balance Lab:
Email unca.balance.lab@gmail.com
QUESTIONS?