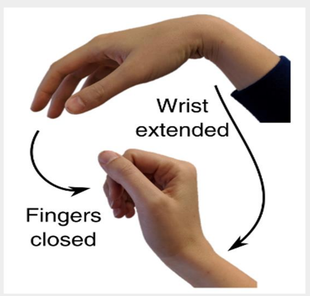
Critical In-Home Evaluation of Robotic and Passive Assistive Grasping Devices in Ten C5-C7 Spinal Cord Injured Participants

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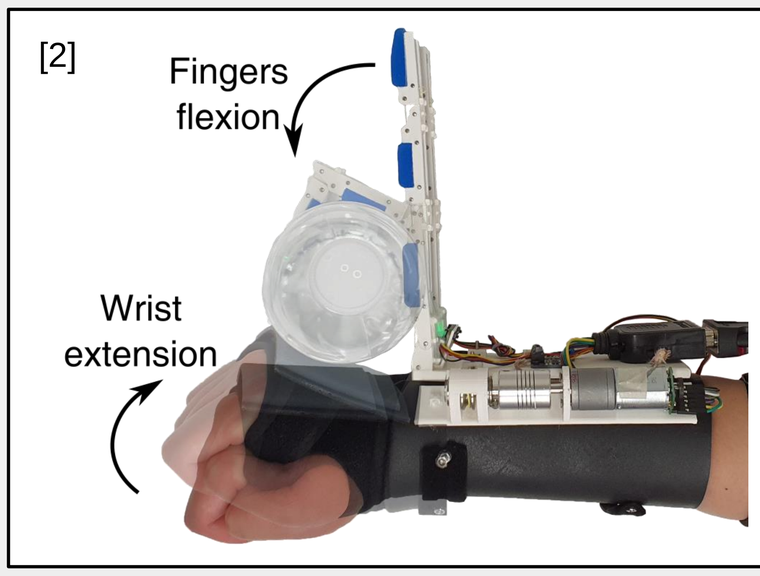
Motivation

- **Spinal cord injury** (SCI) affects an estimated 40 million people worldwide every year [1]. Cervical-level SCI results in tetraplegia, dramatically reducing the ability to perform grasping in common activities of daily living (ADL).
- People with C6-7 SCI generally lose voluntary finger movement, yet retain some wrist movement
- Tenodesis grasp is a compensatory strategy used for passive grasp

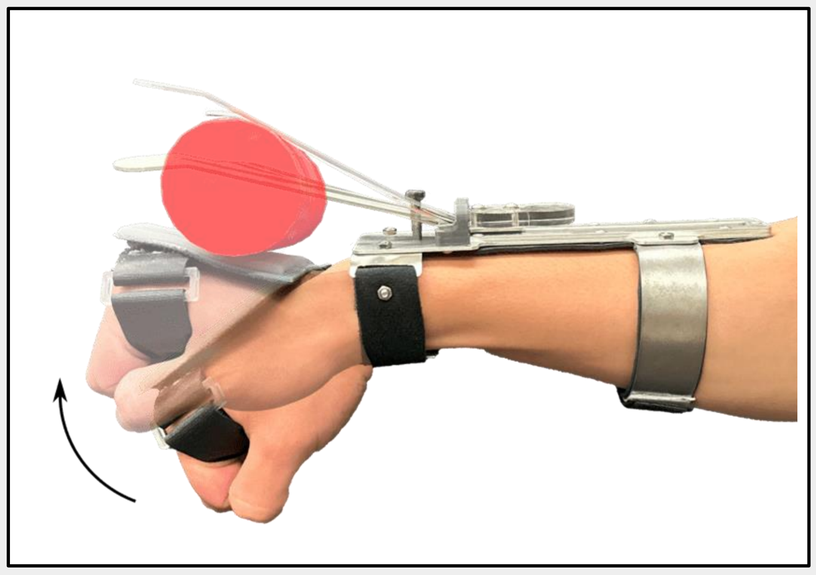


Assistive Devices Tested

Active Dorsal Grasper(A-DG)



Passive Dorsal Grasper(P-DG)



In-Home Study

Study Aims

1. Evaluate device performance
2. Evaluate device interference
3. Determine if perceived usefulness changes w/ tabletop vs ADL use

Study Outline

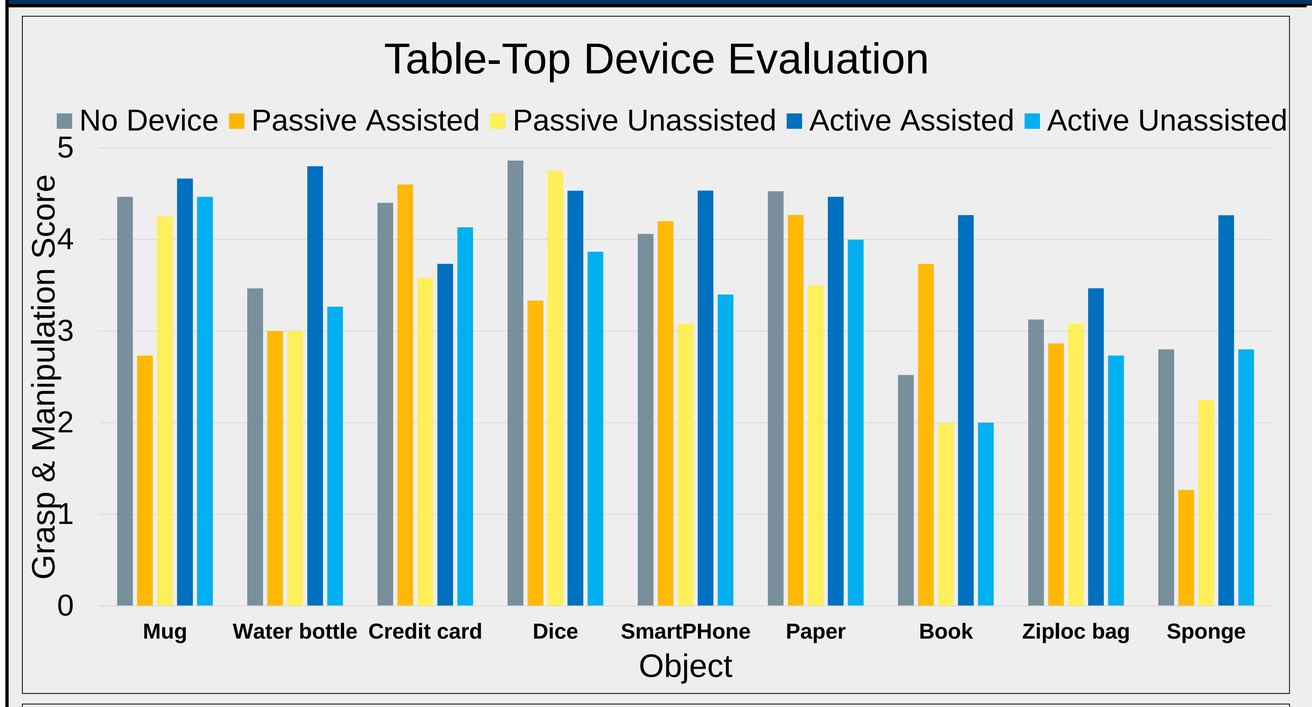
- Biomechanical measurements
- Pre-training session
- **Tabletop Evaluation**
  - Grasp Functionality Test(GFT) - (hand only, with and without each device)
  - Survey scores(SUS, CDUS, CDIS)
- **Activities of Daily Living (ADL) test**
  - In-Home ADL test - (hand only, with and without each device)
    - Prepare hot tea/coffee/drink
    - Prep food
    - Cleaning/organizing activity
  - Survey scores(SUS, CDUS, CDIS)
- **Contextual Inquiry Interview**

New Evaluation Tool

Custom Device Interference Scale(CDIS)

No.	Item	Score
Q1	The device makes it harder to perform tasks	
Q2	The device got in the way of me using my hand	
Q3	The device made it take longer to perform tasks with my hands	
Q4	The device got in the way of reaching into tight spaces	
Q5	The device requires more assistance or effort to don/doff or use the device than no device at all	
Q6	The device physically restricts my movement	
Q7	The device is too heavy, which restricts my movement	
Q8	I became fatigued from using this device	
Q9	I would only put the device on to perform specific, short tasks and then have to take it off to complete my ADL's	
Q10	I would not get the device from a different room to use, even after struggling for 5 minutes to perform a task without it	
Q11	I would not use this device in public, at the grocery store, etc. Given its appearance	
Q12	This device is too uncomfortable or I am concerned it may cause injury if I wear it too long, ie several hours	
Q13	I would have to take off another device (ie push gloves, brace, utensils etc.) before putting on the device	

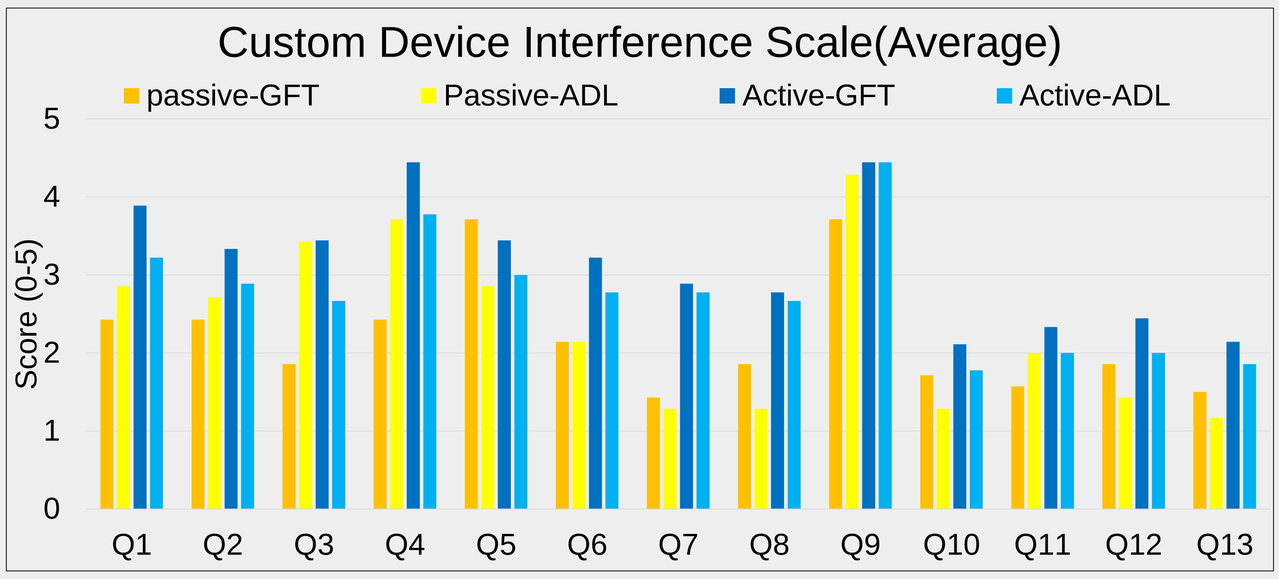
Initial Grasp Functionality Results



Participants
- N = 10, C5-7 SCI participants
- 7 AIS A, 3 AIS C

Scoring (94%)
0 – Unable
3 – Bimanual
5 – Unimanual

Initial Findings:
- A-DG improved baseline for 6 of 10 objects



Initial Findings:
- A-DG received equal or improved ratings after ADL use for all
- P-DG received mixed responses

Conclusion & Future Work

Conclusion

- The A-DG outperformed the P-DG and hand-only baseline for tabletop evaluation with several objects(water bottle, phone, book, sponge) but not all
- The CDIS scores show a change in perceived device usefulness from tabletop eval to ADL use eval

Future Work

- Evaluate grasps gained & lost with each device using a grasp taxonomy[3].
- Access if hand function(UEMS & ASIA) or other factors correlate with device evaluation & sentiment

Acknowledgements & References

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