# Design of Durable Wheelchair Footrests

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# Presentation Outline

- Problem Statement
- Client and Patient Information
- Current Devices
  - Recipient's current and past footrests
- Product Design Specifications
- Preliminary Designs
- Design Matrices
- Future work

# Problem Statement

- The current standard wheelchair footrest is not built to sustain repeated, significant forces
- There are multiple points of failure throughout each footrest including:
    a) Locking mechanism
    b) Footplates
    c) Connecting bolts
    d) Lengthening rod

# Client and Patient Information

- Mark is a 32 year old man with cerebral palsy and an intellectual disability.
- Uses a wheelchair for transportation
- Feet strapped in during transport for safety
- Strength and muscle spasticity: often breaks the foot rests on his wheelchair.

Photo: Andrea Gehling

# Cerebral Palsy and Spasticity

- Cerebral  Palsy
  - Physical disability-movement, muscle coordination, posture
- May be accompanied by:
  - Difficulty with hearing/vision
  - Seizures
  - Intellectual disabilities
- 17 million people worldwide

- Uncontrolled or unpredictable muscle movements
- Seizures cause straightening of legs
- Muscles can be stiff, weak, or tight

# Current Devices- Quickie “IRIS” Wheelchair

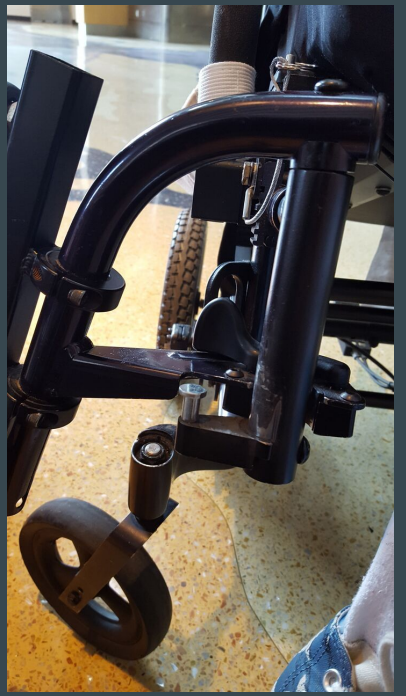
www.sunrisemedical.com

Photo: Andrea Gehling

# Current Footrests

Wheelchair connection and locking mechanism pin

Detached footrest



Footrest in wheelchair connection

Photo: Andrea Gehling

# Points of Failure

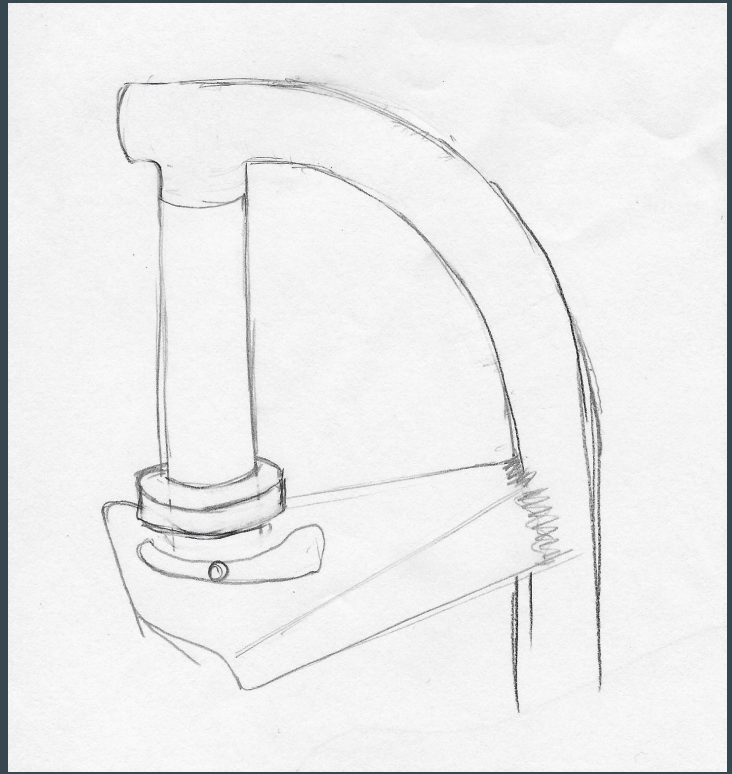
- Locking Mechanism
- Extension bar
- Bolts- along hangers and in footplate

# Design Specifications

- Safe
- Comfortable
- Durable
- Accommodate lift
- Maintains adjustability
- Intuitive for use by single caregiver
- Long-term
  - Transfer to future wheelchairs
- Within budget (TBD)

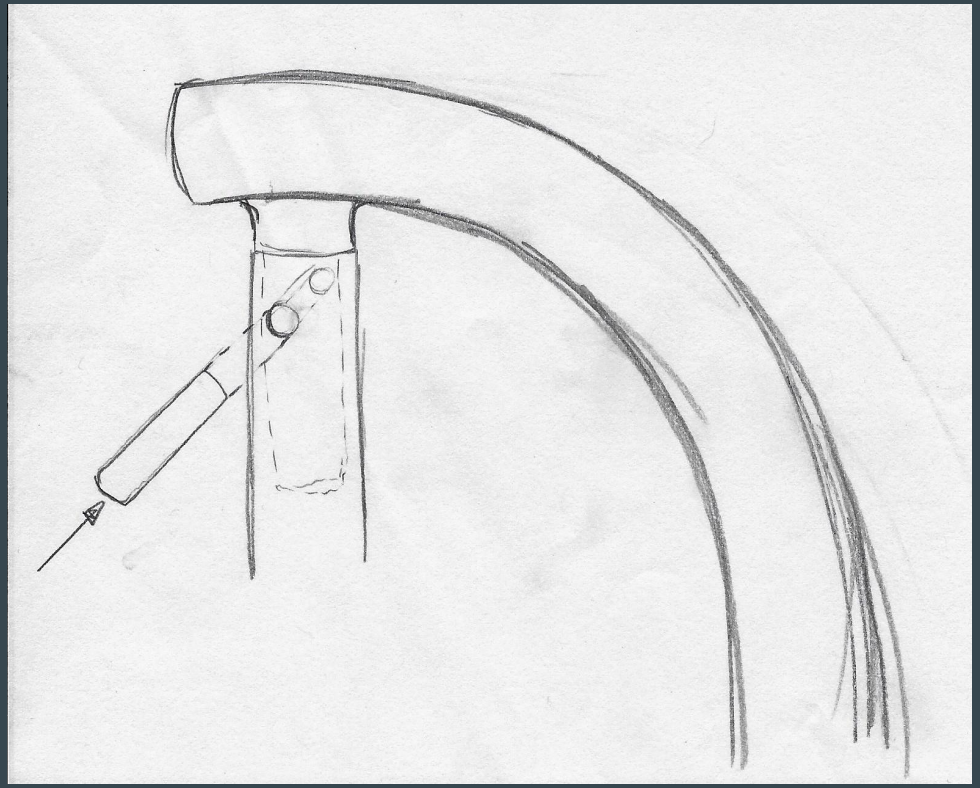
# Upper Hanger and Locking Mechanism

Current Pin and Flange



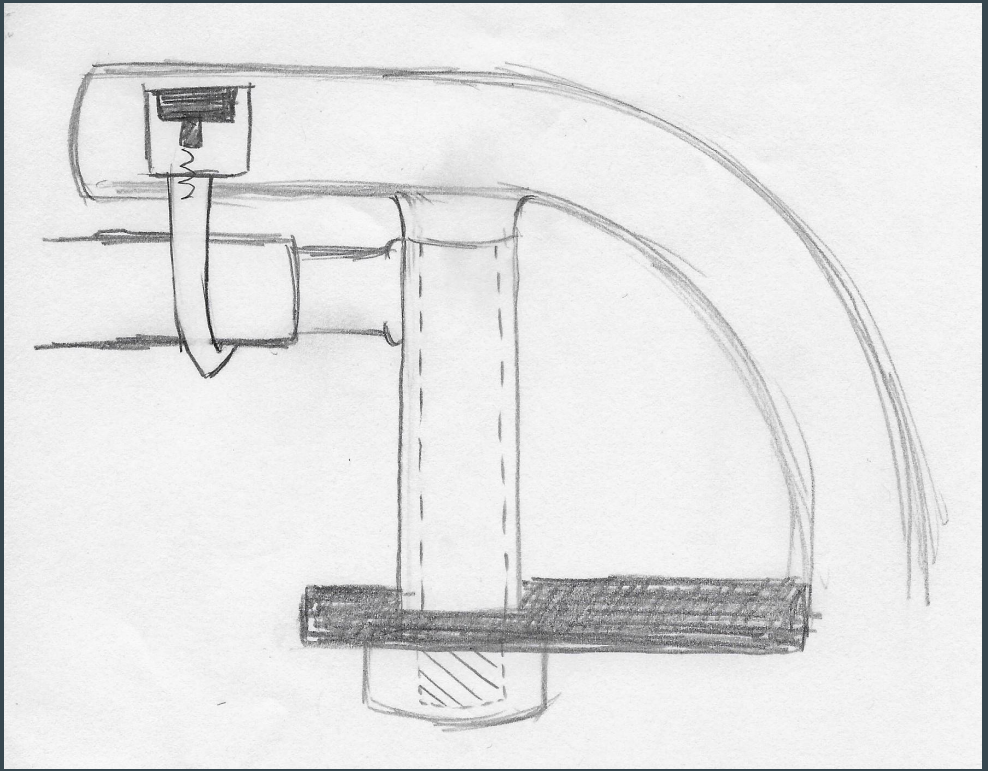
# Upper Hanger and Locking Mechanism

Hole and Pin



# Upper Hanger and Locking Mechanism

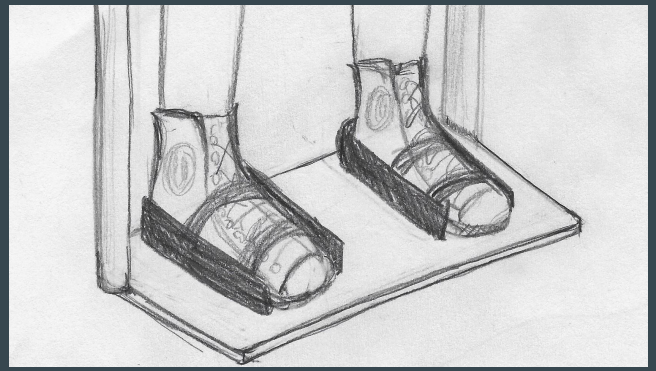
Extended Hanger



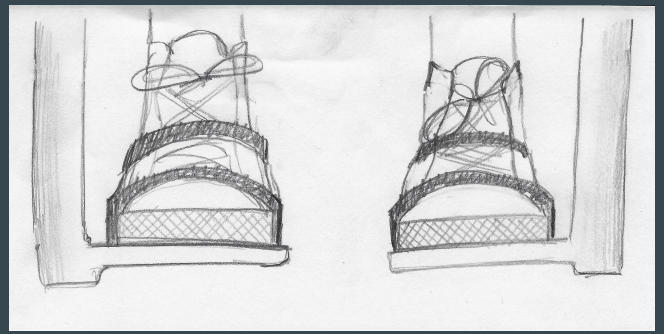
# Design Matrix- Upper Hanger/Locking Mechanism

| Criteria | Weight | Design 1- Current pin & flange | | Design 2- Hole & Pin | | Design 3- Extended Hanger | |
|---|---|---|---|---|---|---|---|
| Durability | 25 | 4 | 20 | 2 | 10 | 5 | 25 |
| Safety | 20 | 5 | 20 | 4 | 16 | 5 | 20 |
| Cost | 15 | 4 | 12 | 5 | 15 | 3 | 9 |
| Range of Motion | 15 | 5 | 15 | 4 | 12 | 4 | 12 |
| Ease of use | 10 | 3 | 6 | 3 | 6 | 3 | 6 |
| Transferable (to future chairs) | 10 | 3 | 6 | 2 | 4 | 4 | 8 |
| Ease of fabrication | 5 | 4 | 4 | 5 | 5 | 3 | 3 |
| **Total** | **100** | | **83** | | 68 | | **83** |

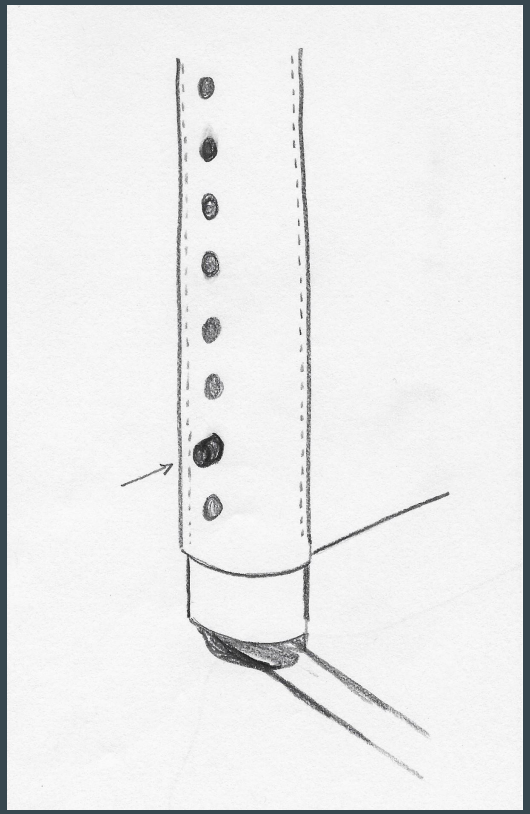
# Lower Hanger and Footplates



Solid Bar, 1 Footplate



Solid Bar, 2 Footplates



Crutch Extender, 2 Footplates

# Design Matrix- Lower Hanger/Footplate Connection

| Criteria | Weight | Design 1- Solid Bar, 1 Footplate | | Design 2- Solid Bar, 2 Footplates | | Design 3- Crutch, 2 Footplates | |
|---|---|---|---|---|---|---|---|
| Durability | 20 | 5 | 20 | 5 | 20 | 4 | 16 |
| Safety | 20 | 5 | 20 | 5 | 20 | 5 | 20 |
| Cost | 15 | 4 | 12 | 5 | 15 | 3 | 9 |
| Comfort | 15 | 3 | 9 | 4 | 12 | 5 | 15 |
| Ease of use | 10 | 3 | 6 | 5 | 10 | 4 | 8 |
| Adjustability | 10 | 1 | 2 | 1 | 2 | 4 | 8 |
| Removability | 5 | 4 | 4 | 5 | 5 | 5 | 5 |
| Ease of fabrication | 5 | 5 | 5 | 4 | 4 | 3 | 3 |
| **Total** | **100** | | 78 | | **88** | | 84 |

# Design Decisions

- Building off of current footrest
  - Current pin & flange
  - Solid bar
  - Two footplates
- Manufacturing from scratch
  - Extended Hanger
  - Solid bar
  - Two footplates

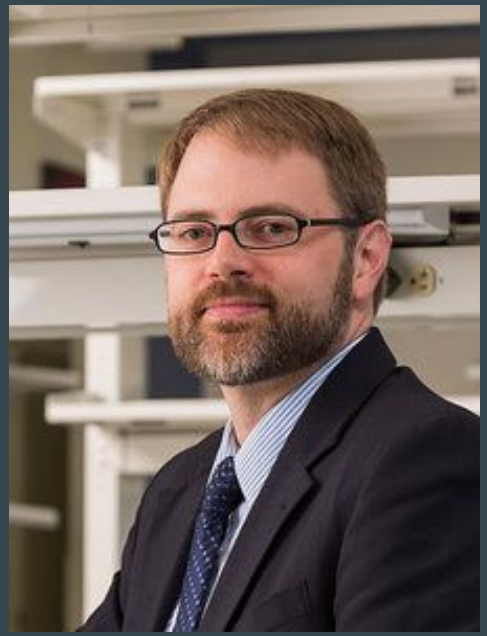
# Future Work

- Finalize budget
- Create a manufacturing plan
- Complete relevant shop training
  - Welding
- Explore acquiring footrest materials
- Measurement specifications
- Fabricate footrests

# Acknowledgements

Client: Mark & Chris Hindle, Andrea Gehling

Advisor: Dr. Jeremy Rogers



vision.wisc.edu/jeremy-rogers.htm

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# Questions?