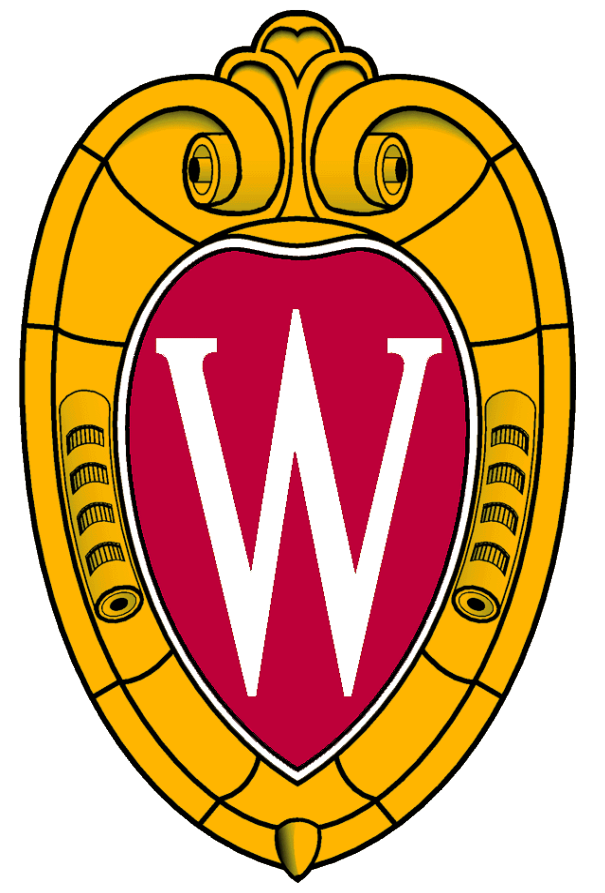




Hand-held Device to Reduce Spasticity



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Abstract

Strokes commonly result in hemiparesis, the partial weakening of one side of the body, and spasticity, the involuntary tightening of muscles. Relaxation of tense muscles can reduce spasticity and improve functioning of the body. The final design incorporates a fabric strap, a shape, and an elastic thumb loop. It was evaluated and surveyed, and may be distributed to others who can also benefit from this device.

Problem Statement

After experiencing a stroke, our client has had problems with walking due to a weakened left side. She has found that placing a ball in her left hand relaxes it, which consequently improves her walking gait. Our goal was to design a convenient, easy to operate hand-held device for use while walking, while at the same time is easy to relocate or remove for tasks with both hands.

Background

Spasticity treatments¹:

- Electrical stimulation of spastic muscles
- Injections of botox
- Physical therapy
 - Stretching is extremely effective
 - Neurological mechanisms unknown
 - Stretching and relaxing muscles may prevent sensory overload and increase function
 - Highly individualized
 - Current commercially available designs are bulky and inconvenient (Figures 1 and 2)



Figure 1: Commercially available Resting Hand Orthosis with Thumb Support holds hand in opened position².



Figure 2: Commercially available Wrist Hand Finger Orthotic for patients with mild spasticity³.



Figure 3: The client's current device, composed of a mini tennis ball and a jogger's strap.

The Client, Carol Rohl:

- Suffered from a stroke seven years ago
- Hemiparetic and spastic along her left side
- Opening hand relaxes spastic muscles
- Her current design consists off a mini-tennis ball secured within her hand by a jogger's strap (Figure 3)

Final Design

Fabric strap:

- Made of cotton
- Tapered design for convenience
- Cotton padding for comfort
- Rests slightly above palm
- Elastic band across back of hand



Figure 4: Prototype with pocket attachment, M&M shape, and thumb loop.

Final Design

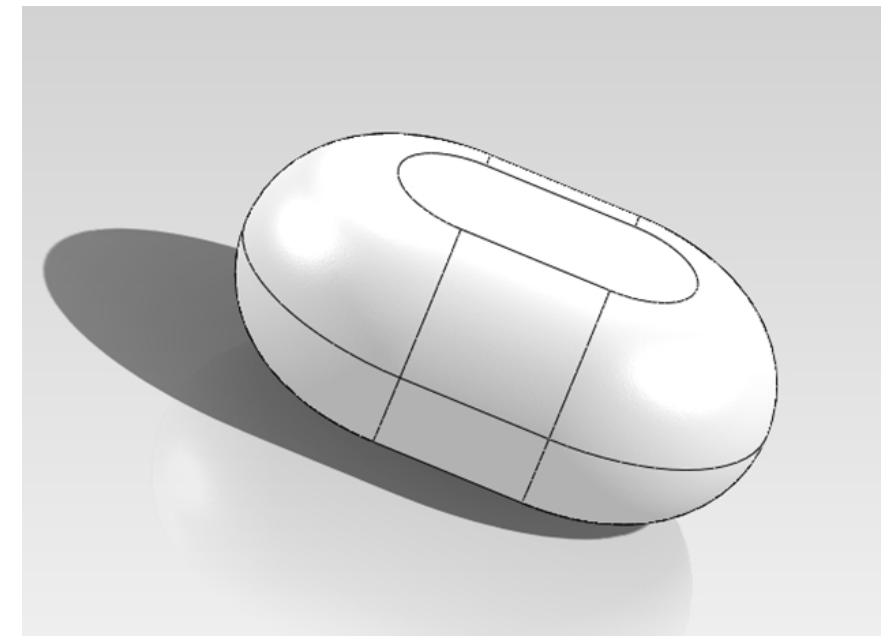


Figure 5: SolidWorks image of the pill shape.

Shape:

- M&M: 2.5 in. x 1.5 in.
- Pill shape: 2.5 in. x 1.5 in. x 3.5 in. (Figure 5)
- Both shapes:
 - Provide stabilization
 - Are convenient when moved to back of hand
 - Keep fingers open and thumb abducted

Elastic thumb loop:

- Recommended by a physical therapist
- Ensures abduction of the thumb (Figure 6)
- Attached with Velcro squares to strap



Figure 6: Elastic thumb loop attached to strap.



Figure 7: Final design for the pill shape.



Figure 8: Final design for the M&M shape.

Testing

- A survey and consent form were developed for administration to college students
- 20 total participants, 10 for each design
- Hand length, wrist, and circumference were measured (Figure 9)
- All subjects tested device using left hand

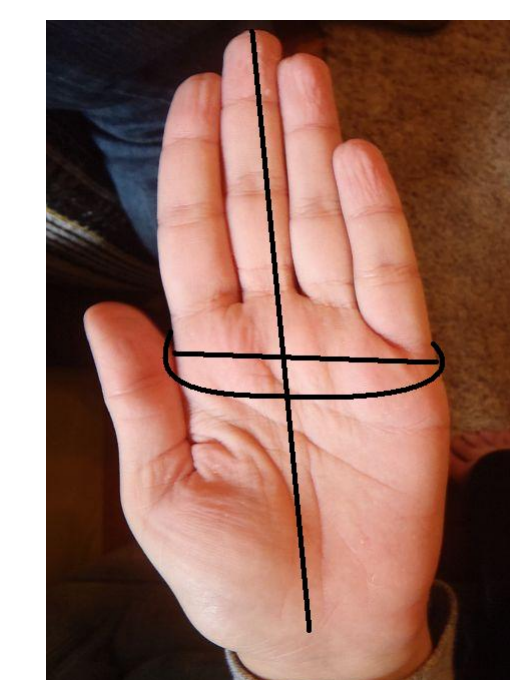


Figure 9: Hand measurements taken during testing.

Results

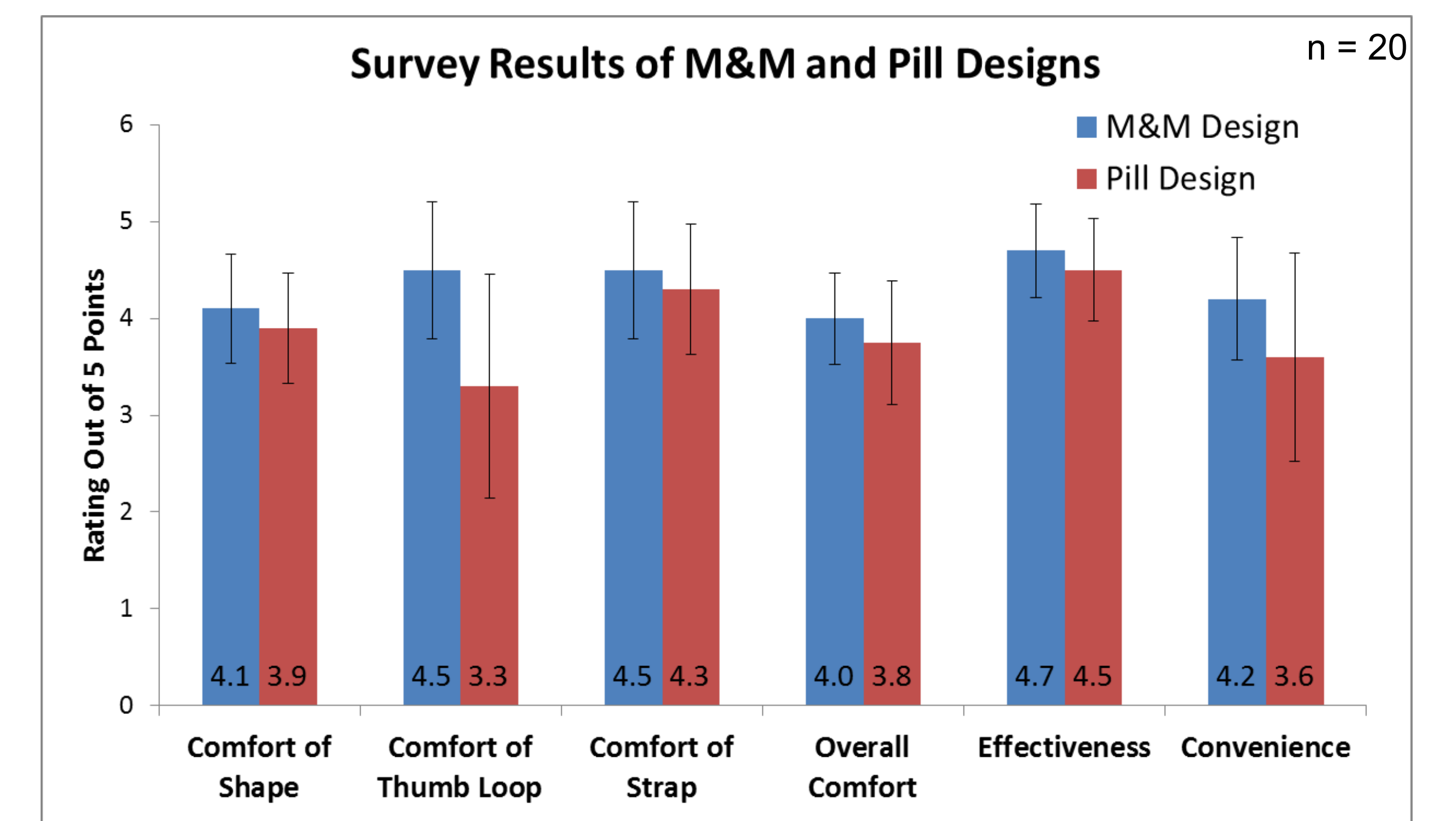


Figure 10: Averaged results of testing for each design with maximum ratings of 5.

Discussion

- All subjects would use device if needed
- No correlation between rated criteria and hand size
- Some participants with larger hand sizes expressed concern about extended wear of the device
- Overall higher ratings for the M&M design

Future Considerations

- Experiment with different weights
- Testing on other spasticity patients
- Design can be generalized and marketed to the public:
 - Adjustable strap
 - Pocket that allows for different shapes
 - Different colors
 - Removable shapes

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