Motum: Mobile Arm Support

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Introduction

Problem Objective

An outpatient, pediatric physical therapy product to assist in the **rehabilitation of upper arm function** for **children with cerebral palsy** or other conditions presenting with arm weakness.

Clinical Need

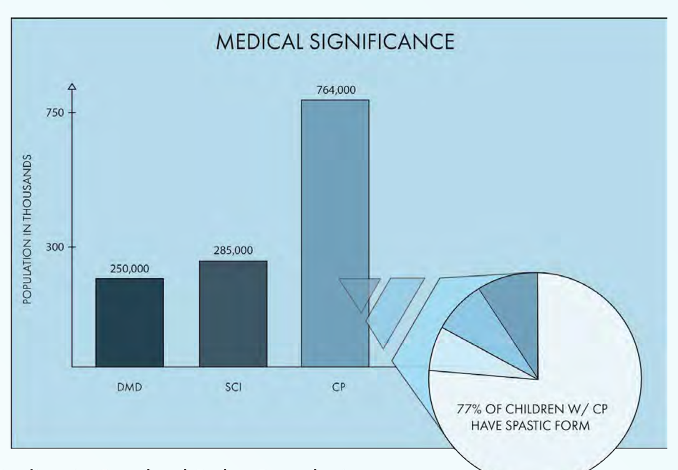

Figure A. *Pediatric Cerebral Palsy Populations*

- 1 in 323 children suffer from cerebral palsy[3]
- 3.3 Children per 1000 births[1]
- 77% Children with CP have Spastic form[3]
- 764,000 Individuals living with CP symptoms[2]
- Mobile arm supports (MAS) help to regain function and complete daily tasks of living

Mobile Arm Support (MAS) Need Criteria

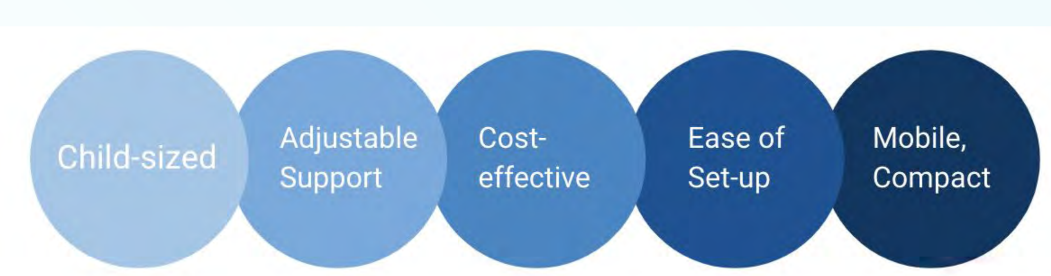

Figure B. *List of Needs for the Device Design*

Current Products

JAECO MAS

Disadvantages
- Uses rubber bands to adjust support
- Difficult to set up
- Trough is too long and too wide for children
- Bulky and cumbersome
- Lacks wrist support

SAEBO MAS

Disadvantages
- Expensive (range from $1000-2000)
- No wheelchair attachment
- Only attaches to a table
- Lacks wrist support

Figure C. *Current mobile arm support products*

Design

Use and Setup

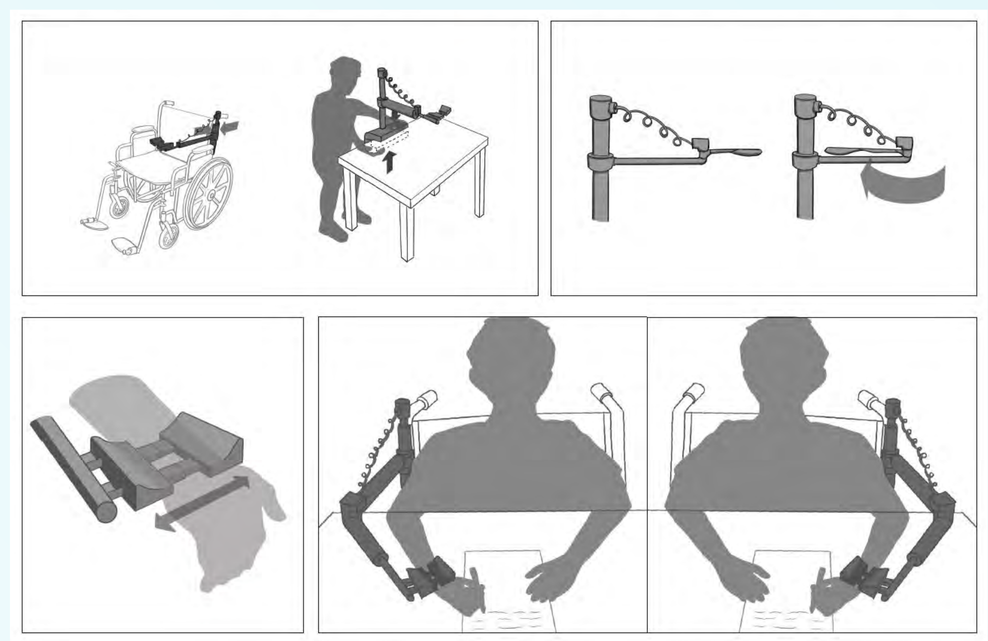

Figure D. *Narrative Storyboard detailing the process, function and features of user interactions*

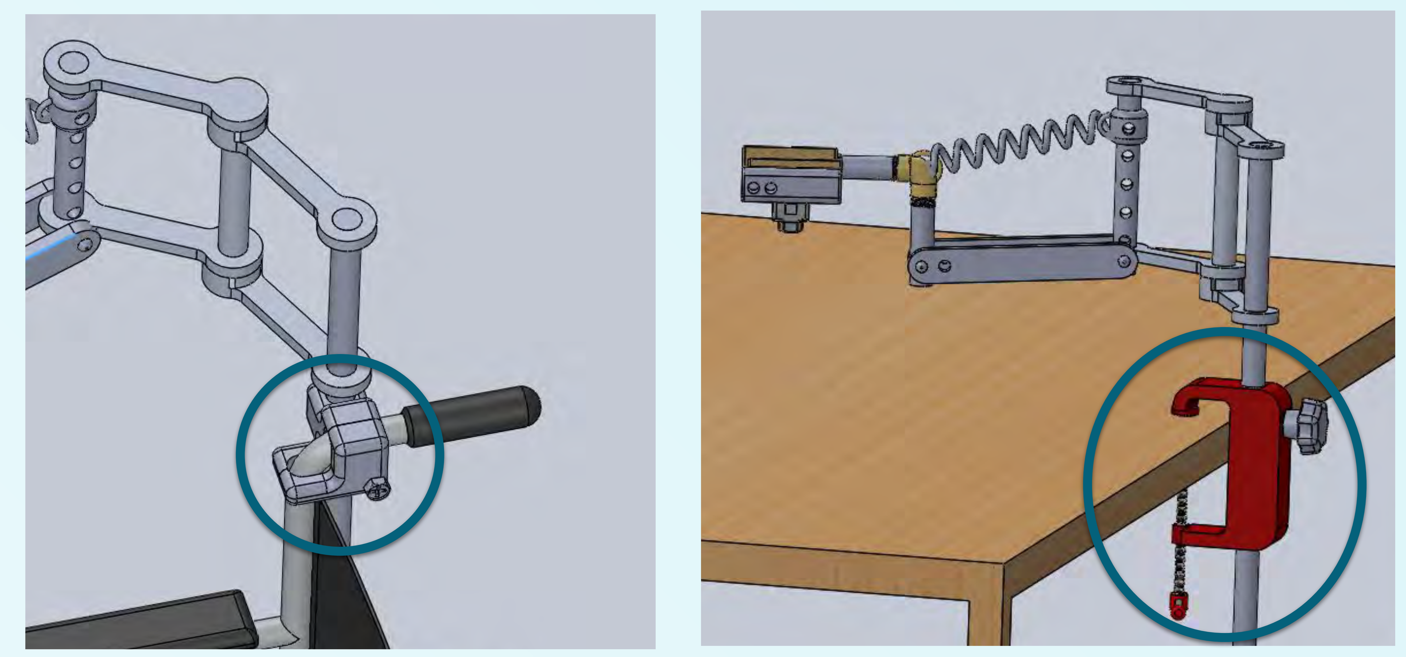

Figure E. *Computer Aided Design (CAD) Assemblies of the wheelchair mount (left) and table clamp (right)*

Adjustable Features

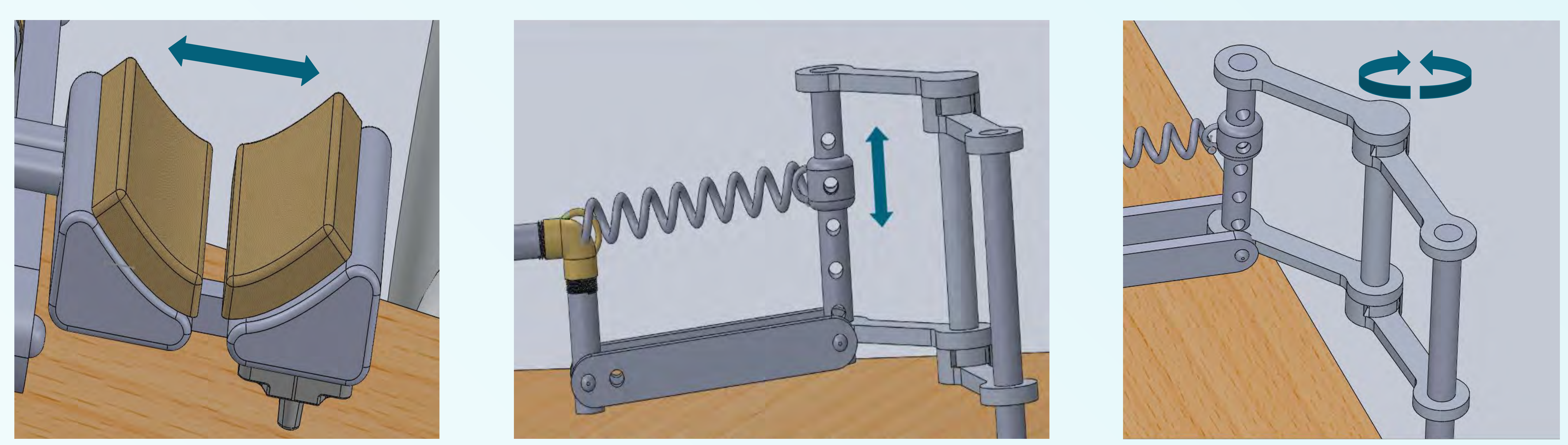

Figure F. *CAD assemblies of adjustable trough (left), adjustable support mechanism (middle), and ambidextrous design (right)*

FEA Analysis and Load Testing

Figure G. *Prototype 2 spring-load testing exhibits massive torsional stresses*

Spring load testing
- Loaded Prototype 2 with various weights to evaluate assembly performance
- Observed major problems with inner acrylic pieces
- Opted for aluminum for proximal pieces to prevent extreme bending and twisting

Results:
- Large torsional forces with minimal loading call for redesign

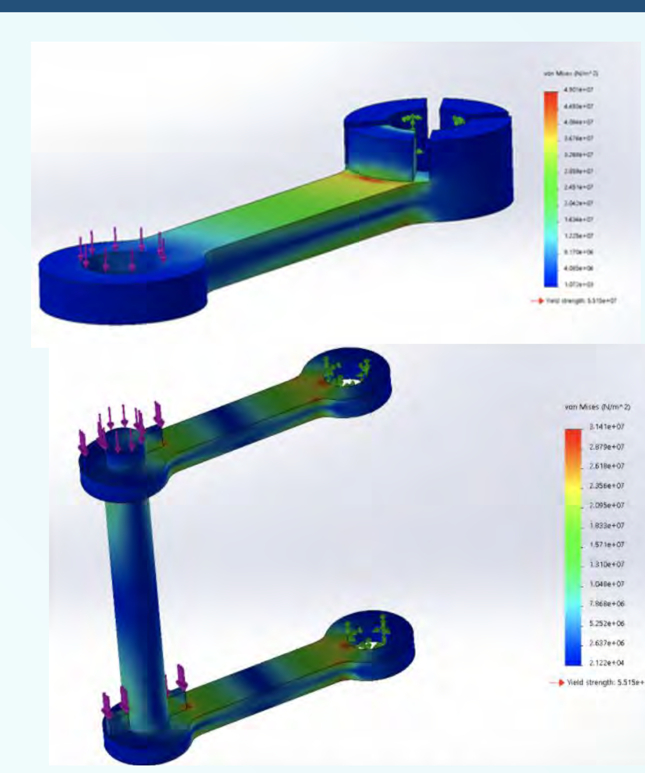

Figure H. *FEA simulations of the ambidextrous component which allows for internal and external rotation*

Finite Element Analysis (FEA)
- Assembly material: 6061 aluminum
- Expected maximum load of 10 lbs on the arm trough
- Used free-body diagram to deduce loads on individual pieces
- Factor of safety 5.6

Results:
- The device can withstand 5.6 times the expected loading

Device Weight
- Expected device weight:

Results:
- The device weighs more than the ideal value, potentially affecting wheelchair function

Market, Manufacturing, Reimbursement

Market

There is a major market gap in mobile arm supports that are **pediatric-specific**, **affordable**, and **easy to use.** Effective mobile arm supports cost upwards of $1000.

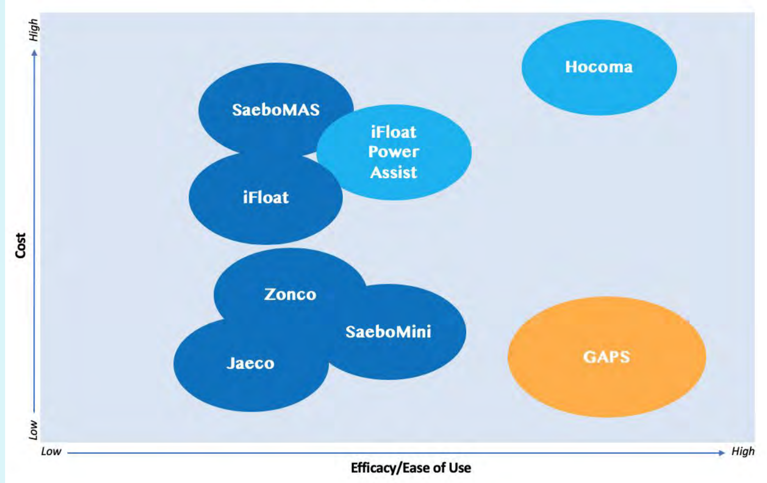

Figure I. *Gaps in the Mobile Arm Support Market, where devices in lighter blue are electronic and dark blue are purely mechanical.*

Manufacturing

The Motum will be made of aluminum and PBA and will be manufactured utilizing metal machining and injection molding. The device in total will cost **around $400/unit** while making a large margin.

Machining	For a robust design, the structural components will be machined out of 6061 Aluminum.
Injection Molding	The arm trough and more distal components will be injection molded for a lighter, cost-effective model.
Off-the-Shelf Components	The table clamp and elbow joint will be purchased off-the-shelf to reduce cost.

Reimbursement

Mobile Arm Supports are not typically covered by insurance, so it is imperative to our product is as cost-effective and accessible as possible.

Patent Search

Although our device improves upon current products, its mechanism of action is similar to that of the Saebo. As such, coordination with Saebo to pursue a licensing agreement may be the best way to achieve a path to market.

Conclusion and Future Work

The Motum addresses a major gap in the market of mobile arm supports. It is pediatric-sized, user-friendly, enables adjustable support, and affordable. We anticipate the Motum will drastically reduce the cost of rehabilitation and allow users to participate more fully in activities of daily living.

Future work could include pursuing more novel mechanisms of support, iterative physical prototyping, and testing with potential users.

Acknowledgements

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