

Product Design Specifications – February 26, 2010

Project #2: Shoulder and Arm Support/Sling

Team Members

Sarah Czaplewski – Team Leader

Megan Halley – BSAC

Nathan Retzlaff – Communicator

Kayla Stankevitz – BWIG

Problem Statement

A sling or other method of support is needed for patients with injuries to the brachial plexus nerves that control the shoulder and arm muscles. Damage to these nerves can result in partial or total loss of motor function of the arm and subluxation of the humeral head from the shoulder socket. Current slings are non-ideal because they hinder patient movement, are uncomfortable to wear, and do not hold the arm in its natural position. The goal of this project is to design an effective and patient-friendly support mechanism that corrects the aforementioned faults of current slings.

Client Requirements

- **Shoulder Placement:** The support device must lift and hold shoulder in a comfortable and natural position. It would be ideal for device to lock shoulder in a position.
- **Useful Forearm/Hand Position:** The forearm should be straight out rather than across the body to enable better use of the hand. No constraints or straps should interfere with hand or wrist movement.
- **Comfort:** Material needs to be breathable to avoid overheating. Also, the device should be easy to put on with only one arm.
- **Aesthetics:** The support should be able to be worn primarily beneath clothes. Any visible components should be black. Also, final design should make the right arm appear larger and more cosmetically pleasing.

Design Requirements

1. Physical and Operational Characteristics

- a. *Performance Requirements:* The sling must reduce shoulder subluxation to a zero finger width gap between the humeral head and the acromion. Also, the device should provide shoulder protection against any incidental contact. As a necessity of the user, the sling should be easy to put on and remove with one hand. If time permits, a hinge mechanism at the elbow should be implemented to allow variation in forearm position.
- b. *Safety:* Any part of the design, especially straps, in contact with skin should not cause severe irritation or cut off circulation. All materials used must be non-allergenic.
- c. *Accuracy and Reliability:* The device should support the arm in the same position and at the same angles every use. The position of the upper arm should be at 20 degree angle

away from the body, the elbow should be at a 90 degree angle, and the forearm should have 0 degree external rotation and elevation.

- d. *Life in Service:* The device needs to withstand approximately 8 hours of use per day. The user will wear the support when at work or while going out in public, but usually not at home. Also, materials of the sling should be able to withstand multiple washes.
- e. *Operating Environment:* All components of the design should be able to withstand normal body and air temperatures, as well as moisture from perspiration. Accidental bumping of the sling should not cause damage.
- f. *Ergonomics:* The supporting device should evenly distribute the weight of the flaccid arm so user's posture and gait are minimally affected.
- g. *Size:* The user should be able to wear the sling under clothing comfortably. The smaller the sling is more cosmetically pleasing it will appear.
- h. *Weight:* The sling should be as light as possible for the comfort of the user.
- i. *Materials:* All materials should be non-allergenic and non-flammable. Also, material covering the skin should be breathable. Materials that can become easily soiled should be washable.
- j. *Aesthetics:* The majority of the device should be able to be worn beneath the users' clothing. Any visible components should be black.

2. Production Characteristics

- a. *Quantity:* One functional prototype of the sling is needed and should be tailored to fit Eric, our target patient. If time permits a second prototype should be completed to give Eric a sling to wear while the other is being washed.
- b. *Product Cost:* Total cost of materials and fabrication should not exceed \$200.

3. Miscellaneous

- a. *Standards and Specifications:* Our support devices will adhere to the specifications laid out by the primary user.
- b. *Customer:* The primary user of sling will be Eric, one of our client's patients. In the future, the design may be adapted to other brachial plexus or stroke patients.
- c. *Competition:* There are many slings on the market. Two slings designed specifically for brachial plexus injuries are the Giv-Mohr sling and WILMER sling.