

# **Dynamic Sling to Support Upper Extremity Post Brachial Plexus Injury to Return to Active Lifestyle – Running**

## **Product Design Specifications**

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### **Function:**

The brachial plexus is the network of nerves that sends motor signals from the spinal cord to the shoulder, arm, and hand. Damage to these nerves results in various levels of control and sensation loss in the arm. The design of a dynamic sling will allow a patient with a brachial plexus injury to return to an active lifestyle. The sling will facilitate natural shoulder movement while maintaining elbow support during running. An adaptable resistance feature will be implemented, allowing the device to develop with the patient as they gain strength during rehabilitation.

### **Client Requirements:**

- A device to support the arm during running or other physical activities
- Comfortable for long-term use (maximum three hours)
- Constructed from washable materials that are breathable and lightweight
- Adjustable in size and resistance to match level of rehabilitation
- Easy to put on quickly with one hand

### **Design Requirements:**

#### **1. Physical and Operational Characteristics**

a. *Performance Requirements:* The sling should support the patient's arm while they engage in activities with moderate shoulder motion, so none of its components should restrict movement of the shoulder joint. Movement will be primarily in the sagittal plane during physical activity. The device should support an elbow angle set by the user while still allowing for flexion and extension. The sling will also be adjustable for varying body types.

b. *Safety:* A snug fit to the patient's arm is necessary but should not be so tight that blood flow is restricted. Additionally, users may have reduced skin surface sensitivity, so the device should not cause pressure sores. Precautions need to be taken when designing the sling to prevent the user from causing more damage to the shoulder.

- c. *Reliability*: The sling should not slip or stretch beyond functional limits during usage.
- d. *Life in Service*: Proper device function should be maintained throughout the entire course of recovery which is approximately 4 years. In the case that full recovery is unreachable, it would be ideal for it to last upwards of 10 years. During non-physical activity the sling may be worn for a maximum of eight hours.
- e. *Operating Environment*: Although it will be used primarily during exercise both outdoors and indoors, the sling could have additional applications in the home or office.
- f. *Ergonomics*: Functionality, comfort, and adjustability for patients of varying body compositions should be considered. It should also be easy to put on with the use of one arm and adjust for varying levels of patient arm strength during recovery.
- g. *Size*: The sling will be an adult size, unisex fit and adjustable for further comfort and support. It will not be bulky so it can be easily worn with everyday clothing.
- h. *Weight*: The device must be lightweight, a maximum of two pounds, so that it can be easily lifted with one arm and worn with little to no detectable weight imbalance.
- i. *Materials*: The sling will be fabricated from a washable, lightweight, and water resistant material. It will be in direct contact with the patient's skin during exercise, so precautions must be taken to prevent chaffing or discomfort.
- j. *Aesthetics, Appearance, and Finish*: Because it will often be worn by patients in public, the device should be aesthetically pleasing. The design should therefore be relatively simple in appearance while still being functional.

## **2. Production Characteristics**

- a. *Quantity*: We are designing one sling with multiple, replaceable elements.
- b. *Total Product Cost*: The target product cost is \$75.

## **3. Miscellaneous**

- a. *Standards and Specifications*: If marketed, the product will require approval from the FDA.

b. *Customer*: The customer is any patient that has suffered a brachial plexus injury, with the design being particularly for those returning to an active lifestyle. The client also envisions the sling being helpful for other injuries such as bone fractures or rotator cuff injuries, and during post operational recovery.

c. *Competition*: Current slings on the market that are designed to support the arm and shoulder after a brachial plexus injury inhibit nearly all movement of the arm and shoulder joint. At the moment, there is no sling that allows natural arm movement during a run while still providing the necessary support.