

Dynamic Sling to Support Upper Extremity Injury to Return to Active Lifestyle - Running

Product Design Specifications

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Function:

The purpose of this design will be to create a shoulder sling to aid in rehabilitation and functionality of patients suffering from shoulder injuries or traumatic brachial plexus injuries. The device must have tensile support of major muscle groups throughout the upper extremity with the ability to vary the amount of support as well as types of support given due to the different degrees of disability in patients with brachial plexus. In order to aid in dynamic rehabilitation, the device must contain design elements that allow for a guided and natural arm swing appropriate to running while having ergonomic specifications that keep the device comfortable during extended periods of exercise.

Client Requirements:

- Anterior and posterior support to the shoulder must be provided as to prevent slouching and create proper body alignment while running.
- Adjustable for different body types and degrees of disability.
- Must contain a compression sleeve or similar component.
- Must extend to the hand to provide support for the wrist.
- Comfortable structure that does not cause abrasion or chaffing.
- Easy to assemble with one hand.
- Secures properly to the body.
- Materials should be easy to clean, light in weight, and breathable as well as reinforced to give appropriate stability.
- If the user so chooses to exercise in the sling on average of four days a week, the sling should be able to last for three to five years.

Design Requirements:

1. Operational and Physical Characteristics

- Performance Requirements:* The support system should be focused on stabilizing the shoulder and keeping the arm in its proper place throughout

running motion. This includes keeping the arm directly at the side of the body, bending the elbow in a ninety degree angle, and creating arm movement about the shoulder. While running, these angles should remain supported throughout the duration of exercise and allow for natural arm swing. Maintaining balance through natural arm swing is critical in maintaining good body mechanics in both the upper and lower extremities.

- b. *Safety:* The sling will be designed so that it will not restrict blood flow, cause abrasions, cause asphyxiation, or facilitate poor running mechanics. Materials should be compatible with the skin, contain no sharp edges, and should be hypoallergenic.
- c. *Reliability:* The sling should function properly throughout operation, and stay secured in its appropriate locations once fastened until removal after exercise.
- d. *Life in Service:* The sling will be designed to last throughout a patient's recovery period. This varies depending on injury, but overall, this time span ranges from approximately three to five years. If the user so chooses to exercise in the sling about four times a week, the device should withstand use up to five years.
- e. *Operating Environment:* The device should be able to withstand the outdoors while in use during exercising, including all types of weather conditions. In addition, the sling will be functional inside different indoor environments of the home, office, or gymnasium.
- f. *Ergonomics:* The sling will not interfere with lightweight clothing, and will be adjustable and comfortable for patients of a small to large build. The design and mechanism of attachment should be simple enough for patients to place and secure the device onto themselves properly with one hand, and without assistance.
- g. *Size:* The size will be adjustable and versions will be made for adults of both sexes. The ranges for mens sizes are approximate and include: small (71 cm in length and 46 cm in width), medium (73 cm in length and 51 cm in width), large (75 cm in length and 53 cm in width), and extra large (78 cm in length and 61 cm in width). The ranges for womens sizes are approximate and include: small (62 cm in length and 46 cm in width), medium (65 cm in length and 51 cm in diameter), large (67 cm in length and 55 cm in width), and extra large (71 cm in length and 61 cm in diameter).
- h. *Weight:* The sling should not cause slouching or weigh down the arm due to an

increased load. The target goal for the weight of the design is approximately 2.25 kg or less.

- i. Materials:* The materials that makes up the design should be hypoallergenic, washable and easy to clean, weather resistant, and breathable. In addition, the sling should be relatively soft in places that it comes into contact with the skin, especially in areas (like the armpit) where excessive rubbing could be a cause of concern. Stretchy materials will also be utilized in specific locations to help accommodate varying sizes in arm thickness and chest sizes, as well as breathable materials to reduce heat. Thicker materials will be used in other locations where reinforcement is required for arm and shoulder support.
- j. Aesthetics, Appearance, and Finish:* The sling will be designed to look sleek and trim since patients will be wearing the device in public.

2. Production Characteristics

- a. Quantity:* There will multiple sling products that will have various ways to adjust to the user. The different sizes should accommodate users and produce a comfortable fit for most individuals.
- b. Total Project Budget Cost:* The intended cost for one sling is approximately \$150.

3. Miscellaneous

- a. Accessories:* The design of the sling will incorporate a utility pocket that will allow for the placement and security of mp3 players, keys, and or other small personal belongings.
- b. Market Approval:* If the sling is successful and reaches market potential, approval by the FDA is required.
- c. Competition:* The current design for a sling on the market that allows for a full arm swing throughout the running motion does not appear to exist. Slings currently on the market completely immobilize the shoulder and arm in a position to the side of the body or across the chest.