Product Design Specifications: Spider Cage

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Function

A spider cage is a device used by therapists to work with people (usually children) who have physical disabilities. Spider cages provide targeted support to an area of the patient's body through bungee cords connected to a suit, harness, or band, and assist with intensive physical therapy programs. The support provided by the bungee cords is adjusted by changing the strength and attachment locations of the cords. Spider cage devices are available commercially, but are prohibitively expensive. The desired product must be relatively inexpensive, collapsible for transport, and created utilizing off-the-shelf components for widespread applications.

Client Requirements

- The device must work for a variety of individuals of varying weight, age, and height.
- The device must include some apparatus to connect the individual to the cage. This apparatus will most likely take the form of elastic suspension bands of varying length and resistance.
- The device must cost less than the commercially made devices priced at $5500.
- The device must have a simple fabrication process using easily obtainable tools and materials.
- The device must include a detailed instruction manual to assist in assembly that will be uploaded to UCPdane.org.

Design Requirements

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

   a. *Performance requirements:* The device should be able to withstand day to day use, and be durable and light enough to be disassembled and transported. The spider cage should provide enough room to allow for the individual to translocate around the cage in each direction. It should provide attachment locations for the necessary elastic straps, and allow these straps to attached or detached to the individual using the cage. This device should allow for an able-bodied individual to facilitate therapy without a trained professional if they so choose.

   b. *Safety:* The spider cage should be strong and stable enough to allow for rapid movement and loads that will exceed the normal weight of the individual.

   c. *Accuracy*: The support provided by the suspension system must be adjustable to target therapy relevant sections of the patient (eg, a specific limb). The strength of the support provided by the suspension system must be adjustable.

   d. *Life in Service:* The device must be able to be used for 2 hour long therapy sessions 5 times per week without wear. The device should also be stored in a temperature controlled environment, and away from excessively humid or dry air.

   e. *Operating environment:* The device is intended for use in the individual's home or in a physical therapist's facility. The device should be capable of being tailored to a specific individual for extended periods of use, but have the capability to be adjusted to

accommodate another individual. The targeted use is for patients of all ages, placing an emphasis on the ability of the cage to accommodate small children.

f. *Ergonomics:* The elastic bands must be reachable and easily adjustable.

g. *Size:* The cage must be tall and wide enough to accommodate anyone. Different attachments must be small enough so that they can be handled easily.

h. *Weight:* The device should be transportable.

i. *Materials:* (To be further discussed and determined): Material for the cage itself should not be sharp. Materials that are resistant to corrosion and rust should be used.

j. *Aesthetics, Appearance, and Finish:* The device should look professionally assembled. Elastic bands should be color coded or labeled in another way in order to identify different strength bungee cords for ease of use.

2. Production Characteristics:

a. *Quantity:* Plans and an instruction manual for the unit will be uploaded to ucpdane.org, with the intention of creating a device that could be readily produced by future patients or patient care providers. Accordingly, the device must be constructed utilizing parts and tools that are commercially available.

b. *Target:* Current research has found that a similar device would cost about $5500. The product can most likely be mass produced, however current manufacturers only custom produce each product. The client would like the device to be as inexpensive as possible without there being an exception to the device's safety.

3. Miscellaneous:

a. *Standards and Specifications:* The device must include a materials list and an instructions manual so it can be uploaded online on the United Cerebral Palsy of Greater Dane County's website for fabrication by other individuals. The cage will not be required to be approved by the FDA for use, but will need to have a finite element analysis performed on it to ensure a reasonable factor of safety for personal use after construction by a third party who does not necessarily have professional training.

b. *Customer:* The customer is Matt Jahnke from United Cerebral Palsy of Greater Dane County. There is currently no specific client for which this cage will be designed, instead, Mr. Jahnke requires that a cage prototype be constructed for which an instruction manual and parts list will be created. These lists will then be uploaded to ucpdane.org, thus allowing any individual to download and construct the cage prototype. Mr. Jahnke has designated that this cage design will be marketed on his website only as a therapy device for cerebral palsy, and will not be marketed as a therapy device for any other purpose. The cage will also likely be constructed in a residential environment in the absence of commercial tools. As a result, the cage should be able to be assembled using common household tools and hardware.

c. *Patient-Related Concerns:* It is recommended that the patient be supervised and assisted during therapy sessions that utilize the cage prototype. The device should be able to be operated by individuals with varying degrees of cerebral palsy with relative ease.

d. *Competition:* There is no commercial competition in the price range desired by the client. There are several models on the internet for approximately $5500.