BME Design-Spring 2020 - Camille Duan
Complete Notebook

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Team contact Information

Camille Duan - Jan 30, 2020, 8:23 PM CST

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Project description

Camille Duan - Jan 30, 2020, 8:29 PM CST

Course Number: BME 402

Project Name: Arm Support for kids with upper difficulties

Short Name: Arm Support

Project description/problem statement:

Kids with upper extremity limitations have difficulty to play with her friends without the help of an adult because they do not have adequate strength to slide their arms. Our mission is to design an arm support to help a 4- year- old girl with great shoulder control to support her elbow and wrist in order to move her arm to pick up game pieces. The design needs to include straps to hold her arm and allow her arms to move in sagittal, transverse and frontal plane by moving her shoulders.

About the client:

Our client is Ms. Megan Schiele, who is an occupational therapist at Madison Metropolitan School District.

2020/02/04 First Client Meeting

James Tang - Feb 29, 2020, 3:19 PM CST

Title: First Client Meeting

Date: 2020/02/04

Content by: Maggie, James

Present: All

Goals: Establish goals and expectation for this project

Content:

Q1: May I know more specifically about the kid's symptome？

No most muscle functions, only some.

Spinal Muscular Atrophy.

Need to lift.

Q2: What resulted in the kid's arm disability?

She was born with it.

Q3: What are the goals of design, what kind of movements?

She can freely move her arm and lift things up.

Q4: What kind of assists is the girl using now?

People.

Q5: How often should we meet?

Any time if a meeting is needed.

Conclusions/action items:

Brainstorm design ideas based on this information.

2020/01/31 First Advisor Meeting

Maggie Zhou - Jan 31, 2020, 1:45 PM CST

Title: First Advisor Meeting

Date: 2020/01/31

Content by: Maggie

Present: All

Goals: Talk about the current status and future timeline

Content:

- PDS and preliminary presentation will be improvised based on the client meeting
- Need to talk about the budget with client
- Use the old format since this is a brand new project
- Brainstorm individually and as a team to talk about design ideas, pick something for the presentation
- Outreach activities, local middle school.

Conclusions/action items:

- Prepare for the presentation and PDS and presentation.

2020/2/14 Second Advisor Meeting

Camille Duan - Feb 24, 2020, 8:55 PM CST

Title: Advisor Meeting

Date: 2020.2.14

Content by: Camille

Present: Team

Goals: To talk about progress and funding

Content:

- Author requirements

-select a journal for publication

-Possibly occupational therapy journal

- Think about more ideas

-continued brainstorming

- Funding

-- Type up a proposal on course page

—Short paragraph explaining the project and the need

—Try different ideas and play with them

—Possible PVC pipes

Conclusions/action items:

—Email the client and potentially visit her to take measurements and how it would work

—Ask her favorite color

2020/02/21 Third Advisor Meeting

James Tang - Feb 29, 2020, 3:21 PM CST

Title: Advisor Meeting

Date: 2.21.2020

Content by: James Tang

Present: Team

Goals: Get advice and plan for next week.

Content:

- Get some slim back bump.
- Find a PT to get help
- Look for weak arm support sources for journal
- Make a material list by Monday for funding proposal use

Conclusions/action items:

Schedule a meeting with Christa for professional views. Finish all tasks listed above.

2020/02/29 Consultant Meeting with Christa

Maggie Zhou - Feb 28, 2020, 3:00 PM CST

Title: Consultant Meeting with Christa

Date: 2020/02/28

Content by: Maggie

Present: All

Goals: Establish a better idea of our current preliminary design

Content:

- Get an idea of what's her current function and condition

- Show the parents the two options we have, ask for their opinion

- Find videos online that have different severity of SMA and try to ask the parents does any one of this video fit.'

- How to find the proper resistance elastic band?

- Maybe bring some rubber bands to the meeting with the kid to see does any fit
- Could we change the length of rubber band?
- Force Analysis Testing (Possibly using MTS machine for testing)
- Testing with the bands, check online how much resistance it has for each band

Conclusions/action items:

Get some resistance bands and play around it to see how well these work. Also take measurements for arms, back maybe. The team met with Christa for a really efficient meeting about the preliminary design ideas and asked about her idea.

2020/03/13 Fourth Advisor Meeting

Maggie Zhou - Mar 13, 2020, 11:01 AM CDT

Title: Fourth Advisor Meeting

Date: 2020/03/13

Content by: Maggie

Present: All

Goals: Establish a general idea for what's the remote class going to be

Content:

- For outreach, we might change the format to online teaching or if the school is cancelled, we are just going to teach Dr. Puccinelli's kids

- We might cancel poster session?

- Prototype manufacturing will be set into designated time.

- The plan is we will purchase material for our new design and make a detailed fabrication plan.

- Fabrication plan will be sent to Dr. Puccinelli and she will connect us to the Makerspace.

- James can email the school about whether they are open

- Paint for PVC needs to be taken care because PVC doesn't stick to the paint well.

Conclusions/action items:

Since the face to face meeting is cancelled, so the alternative method is probably going to meet online with WebEx.

2020/01/30 First Team Meeting

Maggie Zhou - Jan 31, 2020, 1:47 PM CST

Title: Team meeting regarding the scope and future expectation of this project

Date: 2020/01/30

Content by: Maggie

Present: All

Goals: Set up the upcoming event and prepare for the first client meeting

Content:

- Communicate with Dr. Puccinelli regarding PDS and next week's preliminary presentation
- Questions for first client meeting
    - What's the budget for this project and what's ideal reimbursement process?
    - Do we need to fabricate for the arms that move 3D?
    - Do we need a power system to support the device?
    - Are able to meet the client to see the actual condition?
- PDS divided needs to be finished by time.
- Need to update the PDS based on the actual client meeting.

Conclusions/action items:

We don't know that much about this project yet, but team members have been working on research some basic idea that's related to the project.

2020/02/06 Second Team meeting

Maggie Zhou - Feb 24, 2020, 8:42 PM CS

Title: Second Team Meeting

Date: 2020.2.6

Content by: Maggie

Present: Team

Goals: Work on Design matrix and team preliminary presentation

Content:

- The team divide up the work to prepare for the preliminary presentation

- Each person will be in charge of 3-4 slides since we only have three people

- Whoever is in charge of the slides will be presenting them as well

- Time is kind of tight, need to speed up

- Discuss the design matrix criteria and proper score

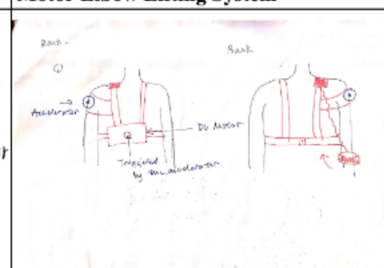
	Suspension Mobile Arm Support		**Motor Elbow Lifting System**		**Mind-control Exoskeleton**	
						
Mechanical Stability & Safety (25)	4/5	20	4/5	20	5/5	25
Patient Comfort (20)	4/5	16	5/5	20	3/5	12
Effectiveness (15)	3/5	9	4/5	12	5/5	15
Ease of Fabrication (15)	5/5	15	4/5	12	1/5	3
Cost (15)	5/5	15	4/5	12	1/5	3
Ease of Operation (10)	3/5	6	4/5	8	5/5	10
Total (100)	**81**		**84**		**68**	

Figure 1. Draft of design matrix, subject to change based on change of design

Conclusions/action items:

The team met and basically assigned roles for the preliminary presentation since we are kind of in a rush for this presentation so each person has to complete his/her task in time! We also create the design matrix for this semester design so that we could evaluate the designs better. We need to meet again some time next week to decide our final design and all the designs are subject to changes.

2020/2/13 Third Team Meeting

Camille Duan - Feb 13, 2020, 9:08 PM CST

Title: Third Team Meeting

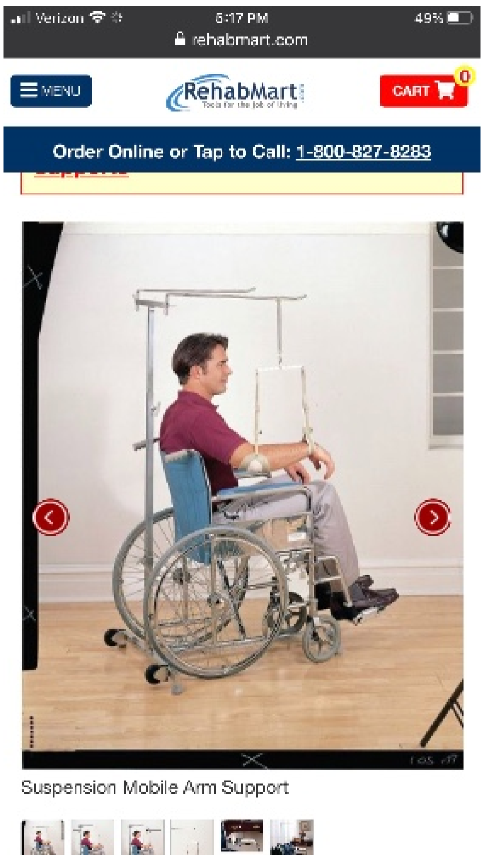
Date: 2020.2.13

Content by: Camille

Present: Team

Goals: To decide on final design and brainstorm new ideas

Content:



Conclusions/action items:

2020/2/23 Funding Proposal

Title: Funding Proposal

Date: 2020.2.23

Content by: Camille

Present: Team

Goals: To finish funding write up and create a list of needed materials

Content:

We are the team of Arm Support and we are writing to propose funding from the BME Department for this semester's design project. Our client wants the team to design a do not have the adequate muscle strength to slide their arms. Our mission is to design arm support to help a 4-year-old girl with great shoulder control to support her elbow depending on the further development of the design.

After several discussions with the pediatric occupational therapist, we came up with two theoretically equally feasible design ideas that could potentially work. The first tube for hand positioning. The second design involves creating a ground stabilization system. PVC tubes will also be used for the second design (shown in figure 1 below). design prototypes early will allow us to have efficient time for testings, which will further assist us in finding our design deficiencies with a goal of creating a final design t

Item	Quantity	Link
Design 1. (Arm Supporting Vest)		
PVC Tubes	3	https://www.homedepot.com/p/Apollo-1-2-in-x-5-ft-White-PEX-Pipe-APPW512/301541214?mtc=Shopping-VF-F_D26P-G-D26P-26_1_PIPE_AND_FITTINGS-Generic-NA-Fe 92700042233378833&gclid=Cj0KCQiAv8PyBRDMARIsAFo4wK0FknXax_7vDvdmqUzz_o0tr6T2KBX0FmZnb6olpDvSqqAb0jLaeo8aAuzOEALw_wcB&gclsrc=aw.ds
½ in. PVC coupling	1	https://www.homedepot.com/p/Charlotte-Pipe-1-2-in-PVC-Coupling-SxS-35-Pack-PVC-02100-0635HD/307851835
½ in. PVC 90 degree S x S Elbow	10	https://www.homedepot.com/p/Charlotte-Pipe-1-2-in-PVC-Sch-40-90-Degree-S-x-S-Elbow-PVC023000600HD/203812033
½ in. PVC Fitting	8	https://www.homedepot.com/p/DURA-1-2-in-PVC-El-with-Side-Outlet-90-SxSxS-C413-005/203468280

Back Straighten Vest	1	https://www.amazon.com/Posture-Corrector-Teenager-Clothes-Humpback/dp/B07PFGRM55/ref=asc_df_B07PFGS3V5/?tag=&linkCode=df0&hvadid=343269713726&hvpos=&l
Rubber band	1	https://www.amazon.com/iCraft-3-Inch-Colored-Elastic-Blue13020/dp/B01895EMH4/ref=sr_1_3_sspa?keywords=6+inch+wide+elastic&qid=15 spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEyWEY1OEUwMzdGNVVDJmVuY3J5cHRlZElkPUEwNTYyMzU4MzYwSUUwN
Design 2.		
Linear Rail Guide with MGN12H Carriage Block	1	https://www.amazon.com/Iverntech-Linear-Carriage-Printer-Machine/dp/B077MFSF5F/ref=asc_df_B0762MPVN3/?tag=&linkCode=df0&hvadic 542439372938&ref=&adgrpid=57645286690&th=1
Arm Sling	1	https://www.amazon.com/Shoulder-Fashion-Colorful-Children-Padiatric/dp/B07TQJBSTK/ref=sr_1_9?keywords=arm%2Bsling%2Bfor%2Bkids
Total		

Conclusions/action items:

Receive funding and start working on creating prototypes with different materials and start testing process.

2020/2/26 Journal Selection for Publication

Camille Duan - Feb 26, 2020, 4:58 PM CST

Title: Journal Selection

Date: 2.26.2020

Content by: Camille

Present: Camille

Goals: To find journal for possible publication of the design project

Content:

Reference: <https://jneuroengrehab.biomedcentral.com/about?gclid=EAIaIQobChMIqabT-6Hw5wIVbx-tBh2J0gtrEAAYASACEgLopfD_BwE>

- **Journal of Neuroengineering and Rehabilitation**
  - Impact factor: 3.07 (2019)
  - Author requirement: considers manuscripts on all aspects of research that result from cross-fertilization of the fields of neuroscience, biomedical engineering, and physical medicine and rehabilitation. *JNER* provides a forum for researchers and clinicians interested in understanding the way neuroscience and biomedical engineering are continuing to reshape physical medicine and rehabilitation.
  - Manuscripts submitted to *Journal of NeuroEngineering and Rehabilitation* will be evaluated initially by the Editor-in-Chief, and then assigned to an Associate Editor who is responsible for designating at least two reviewers in order to assess the scientific quality of the submitted material.
- **Journal of Physical and Occupational Therapy in Pediatrics**
  - Reference: **<**https://www.tandfonline.com/action/authorSubmission?show=instructions&journalCode=ipop20>
  - impact factor: 1.56 (2019)
  - H-Index: 39
  - Requirement: international, peer-reviewed journal publishing high-quality, original research. Accepts the following types of article: original articles, perspective, systematic review, meta-analysis, scoping review.
  - *Original Research* – POTP publishes all types of original research including single subject designs and validation of a test or measure.
- **Journal of Occupational Rehabilitation**
  - Reference: <https://www.springer.com/journal/10926>
  - Impact factor: 2.242 (2018)
  - an international forum for the publication of peer-reviewed original papers on the rehabilitation, reintegration, and prevention of disability in workers. The journal offers investigations involving original data collection and research synthesis (i.e., scoping reviews, systematic reviews, and meta-analyses). Papers derive from a broad array of fields including rehabilitation medicine, physical and occupational therapy, health psychology and psychiatry, orthopedics, oncology, occupational and insurance medicine, neurology, social work, ergonomics, biomedical engineering, health economics, rehabilitation engineering, business administration and management, and law.
  - Title page: The name(s) of the author(s); A concise and informative title ;The affiliation(s) and address(es) of the author(s); The e-mail address, telephone and fax numbers of the corresponding author
  - Abstract: Purpose (stating the main purposes and research question) ;Methods ;Results ;Conclusions
- **Journal of Mechanics in Medicine and Biology**
  - Reference: < https://www.worldscientific.com/worldscinet/jmmb>
  - Impact factor: 0.468
  -

Conclusions/action items:

2020/1/29 Classification of Upper Limb Disability

Camille Duan - Jan 30, 2020, 10:42 PM CST

Title: Classification of Upper Limb Disability

Date: 2020.1.29

Content by: Camille

Present: Camille

Goals: To understand Upper Limb Disability of Children

Content:

Reference: < Raouafi, S., Achiche, S., Begon, M., Sarcher, A., & Raison, M. (2018). Classification of upper limb disability levels of children with spastic unilateral cerebral palsy using K-means algorithm. *Medical & Biological Engineering & Computing*, *56*(1), 49–59. https://doi-org.ezproxy.library.wisc.edu/10.1007/s11517-017-1678-y>

Spastic unilateral cerebral palsy (SUCP) is one of the most common types of cerebral palsy. It is characterized by unilateral loss of functions of the upper and lower extremities. This disability has a major negative and devastating effect on children's development and on their quality of life. Children may have intellectual disability, hearing and visual deficits. Cerebral palsy has also a lifelong effect on physical, emotional, social, psychosocial and school functioning . Children with SUCP have limited active ranges of motion of their involved upper limb (IUL) , especially reduced extension and supination . This neurological disorder leads to excessive stiffness and weakness of the pronator and flexor muscles. In this context, antispasticity agents were often used to manage spasticity and it was improved that they significantly reduce muscle tone and overactivity. These treatments may decrease the spasticity but not necessarily strengthen the range of motion.

The K-means algorithm succeeded in identifying four different clusters which related to MACS levels ($p = 0.01$). Using only the two most pertinent parameters, the Falconer index and maximal angle extension, we can classify disabilities of children with SUCP. We believe that our K-means clustering approach has interesting implications for objective-based research. Former studies involved extensive classifications to depict the IUL deformity without elaborating a particular explanation. The classification accorded here eases the recognition of different pathologies that shape a specific group, and offers a more particularized estimation of severity of SUCP children.

Conclusions/action items:

2020/1/29 Upper Limb Anatomy

Camille Duan - Feb 24, 2020, 9:37 PM CST

Title: Upper Limb Anatomy

Date: 2020.1.30

Content by: Camille

Present: Camille

Goals: To research the basic anatomical structure of human/kids upper limb

Content:

Reference: <Forro SD, Lowe JB. Anatomy, Shoulder and Upper Limb, Arm Structure and Function. [Updated 2019 Apr 7]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507841/>

The upper extremity begins at the shoulder joint. It is more correctly described as a ball-and-saucer joint. In contrast to the hip, the other ball-and-socket joint of the body, the socket is much shallower. This allows for less restriction of movement at the joint but compromises stability in the process. The elbow joint is referred to by many as a hinge joint. This is partially true but does not explain the ability to pronate and supinate the forearm at the elbow joint. The articulation of the radial head and the radial notch on the ulna allows for this motion. This creates what is called a "pivot" joint, allowing the movement of one bone on another. The wrist joint can be classified as an ellipsoidal or condyloid joint. There are also joints of the carpal bones, which are referred to as intercarpal joints. Even though they are synovial joints, they do not allow much movement. The interphalangeal joints are basic hinge joints.

The musculature of the upper limb is quite vast, much more so than the lower extremity. The upper arm contains three muscles in the anterior compartment. The long and short head of the biceps brachii are located superiorly while the coracobrachialis and brachialis are deep to the biceps. The posterior compartment contains only one muscle, the triceps brachii. The forearm consists of 20 muscles, separated into five compartments. Biceps brachii tendon rupture is a common pathology seen with flexion at the elbow. Patients typically present with a bulge in the anterior arm, sometimes referred to as “Popeye sign,” after hearing a loud pop during the injury.

The anterior forearm consists of four muscles in the superficial group: flexor carpi radialis, flexor carpi ulnaris, palmaris longus, and pronator teres. The lone muscle in the intermediate/middle compartment is the flexor digitorum superficialis. The deep layer of the anterior compartment contains three muscles: flexor digitorum profundus, flexor pollicus longus, and pronator quadratus. These muscles consist of mainly flexor and pronator muscles, and most of the superficial muscles arise from a common flexor tendon on the medial epicondyle of the humerus. Overuse of the superficial flexor muscles can lead to a syndrome known as medial epicondylitis, which is sometimes referred to as "golfer's elbow." Repetitive pronation/flexion leads to pain near the medial epicondyle, which worsens with use.

The posterior forearm is separated into two compartments, superficial and deep, with seven and five muscles, respectively. The superficial compartment consists of anconeus, brachioradialis, extensor carpi radialis longus and brevis, extensor carpi ulnaris, extensor digitorum, and extensor digiti minimi. The deep compartment contains abductor pollicis longus, extensor indicis, extensor pollicis longus and brevis, and supinator. As with the anterior superficial compartment, the majority of the superficial muscles of the posterior compartment arise from a common extensor tendon; this time arising from the lateral epicondyle. The main actions of the muscles in the posterior forearm are extension and supination. Like the flexors in the anterior department, the superficial extensor also can suffer from an overuse injury. This syndrome is referred to as tennis elbow or lateral epicondylitis.

The muscles of the hand can be subdivided into three groups, which are muscles of the palm, thenar muscles, and hypothenar muscles. The thenar muscles are located at the thumb, and consist of abductor pollicis brevis, flexor pollicis brevis, and opponens pollicis. The median nerve innervates all three of these muscles. The hypothenar muscles are located at the ulnar side of the hand, near the five digit, or pinky finger. They are the abductor digiti minimi, flexor digiti minimi brevis, and opponens digiti minimi. The ulnar nerve innervates them all. The third group of muscles consists of two single muscles and three groups of muscles. The single muscles are palmaris brevis and adductor pollicis. The first group is the dorsal interossei, which consists of four muscles attaching to the metacarpals, which are responsible for abduction of the fingers. The second group, the palmar interossei, are three (some anatomy texts report four) muscles located on the anterior surface of the metacarpals. They are responsible for adduction of the fingers. The ulnar nerve innervates both the palmar and dorsal interossei. There are also four lumbrical muscles in the hand. Each of these muscles originates from the tendon of the flexor digitorum profundus and is responsible for flexion of the finger at the metacarpal-phalangeal joint and extension of the interphalangeal joints. The radial two lumbricals are innervated by the median nerve, while the ulnar nerve innervates the two on the ulnar side. There are no lumbricals associated with the thumb.

2020/2/10 SMA Research

Camille Duan - Feb 24, 2020, 7:08 PM CST

Title: Spinal Muscular Atrophy Research

Date: 2020.2.10

Content by: Camille

Present: Camille

Goals: To understand the cause and symptoms of SMA

Content:

“Spinal muscular atrophy - Genetics Home Reference - NIH,” *U.S. National Library of Medicine*. [Online]. Available: https://ghr.nlm.nih.gov/condition/spinal-muscular-atrophy. [Accessed: 06-Feb-2020]

Spinal muscular atrophy is a genetic disorder characterized by weakness and wasting in muscles used for movement (skeletal muscles). It is caused by a loss of specialized nerve cells, called motor neurons that control muscle movement. The weakness tends to be more severe in the muscles that are close to the center of the body compared to muscles away from the body's center (distal). The muscle weakness tends to be more severe with age.

Spinal muscular atrophy type 0 is evident before birth and is the rarest and most severe form of the condition. Affected infants move less in the womb, and as a result they are often born with joint deformities (contractures). They have extremely weak muscle tone (hypotonia) at birth. Their respiratory muscles are very weak and they often do not survive past infancy due to respiratory failure. Some infants with spinal muscular atrophy type 0 also have heart defects that are present from birth (congenital).

Spinal muscular atrophy type I (also called Werdnig-Hoffmann disease) is the most common form of the condition. It is a severe form of the disorder with muscle weakness evident at birth or within the first few months of life. Most affected children cannot control their head movements or sit unassisted. Children with this type may have swallowing problems that can lead to difficulty feeding and poor growth. They can also have breathing problems due to weakness of respiratory muscles and an abnormally bell-shaped chest that prevents the lungs from fully expanding. Most children with spinal muscular atrophy type I do not survive past early childhood due to respiratory failure.

Spinal muscular atrophy type II (also called Dubowitz disease) is characterized by muscle weakness that develops in children between ages 6 and 12 months. Children with this type can sit without support, although they may need help getting to a seated position. However, as the muscle weakness worsens later in childhood, affected individuals may need support to sit. Individuals with spinal muscular atrophy type II cannot stand or walk unaided. They often have involuntary trembling (tremors) in their fingers, a spine that curves side-to-side (scoliosis), and respiratory muscle weakness that can be life-threatening. The life span of individuals with spinal muscular atrophy type II varies, but many people with this condition live into their twenties or thirties.

Spinal muscular atrophy type III (also called Kugelberg-Welander disease) typically causes muscle weakness after early childhood. Individuals with this condition can stand and walk unaided, but over time, walking and climbing stairs may become increasingly difficult. Many affected individuals require wheelchair assistance later in life. People with spinal muscular atrophy type III typically have a normal life expectancy.

Spinal muscular atrophy type IV is rare and often begins in early adulthood. Affected individuals usually experience mild to moderate muscle weakness, tremors, and mild breathing problems. People with spinal muscular atrophy type IV have a normal life expectancy.

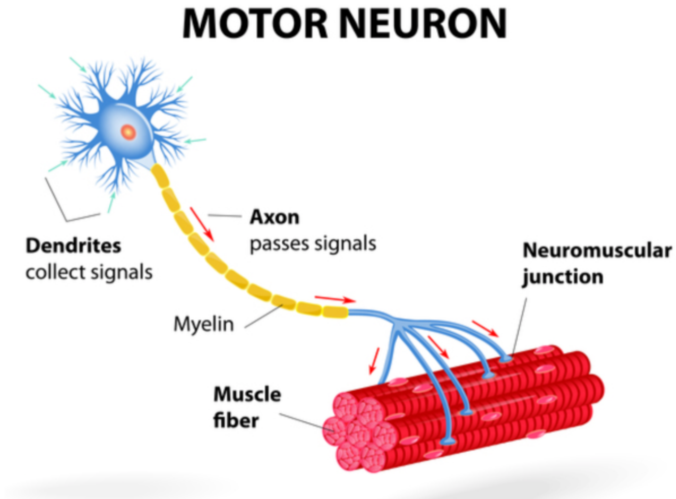


Figure 1. Sample motor neuron function demonstration

Conclusions/action items:

From the research at NIH, there are four different types of SMA. Though the 4-year-old girl is not diagnosed with SMA, her symptoms are very similar with SMA kids that she also has muscle weakness. Her symptoms are also most similar to type II SMA in that she was not born with this disorder and it became worse over the years.

2020/02/20 SMA significance/ impact

Camille Duan - Feb 24, 2020, 8:35 PM CST

Title: SMA significance data research

Date: 2020.02.20

Content by: Camille

Present: Camille

Goals: To find out the number of SMA kids every year and the impact of this disorder

Content:

Reference: <"SMA Foundation," *SMA Foundation*. [Online]. Available: https://smafoundation.org/about-sma/. [Accessed: 20-Feb-2020].>

SMA is caused by defects in the Survival Motor Neuron 1 (SMN1) gene that encodes the SMN protein. The SMN protein is critical to the health and survival of the nerve cells in the spinal cord responsible for muscle contraction (motor neurons).

SMA has generally been believed to affect as many as 10,000 to 25,000 children and adults in the United States, and therefore it is one of the most common rare diseases. One in 6,000 to one in 10,000 children are born with the disease. One in 40 to one in 50 people (approximately 6 million Americans) are carriers of the SMA gene. SMA is an autosomal recessive genetic disease, meaning that a person must have two copies of a defective gene to have the disease. SMA carriers do not exhibit SMA symptoms, but do carry a defective copy of the SMN1 gene. If both parents are carriers of the SMA gene, then each of their children has a 1 in 4 chance of having the disease. SMA has multiple forms which vary in severity. The most severe form (Type I) manifests before 6 months of age and generally results in death before age two. Patients with milder forms of SMA may not have symptoms of muscle weakness until much later in childhood or even as adults. The SMA Foundation has prepared a number of informational materials about the disease and the care of SMA patients.

The genetics of SMA provides a unique opportunity for therapeutic development. While SMA patients lack the functional SMN1 gene, they do have a "backup" gene, SMN2. SMN2 also makes SMN protein, but at greatly reduced efficiency, leading to lower than normal levels of the protein. SMN2 provides an attractive target for developing SMA therapeutics, and the majority of drug development efforts in the field are focused on increasing SMN protein production from this gene.

Conclusions/action items:

SMA (spinal muscular atrophy) is one of the most common rare diseases in the United States. It affects 1 in every 6000 to 10,000 new borns in the United States. Since children who are born with this disease typically are diagnosed with type I, which is the most severe type of SMA disorder.

2020.2.24 Upper Limb Biomechanics

Camille Duan - Feb 24, 2020, 8:53 PM CST

Title: Upper limb biomechanics

Date: 2020.2.24

Content by: Camille

Present: Camille

Goals: To learn about the biomechanics of upper limb to better help with design

Content:

Reference:< https://ph.pollub.pl/index.php/jteme/article/view/517/263>

1. Range of motion

The shoulder joint allows to perform motions such as abduction and adduction (coronal plane), flexion and extension (sagittal plane), horizontal abduction and adduction (transverse plane), and also internal and external rotation. In the elbow joint, there are two pairs of possible moves - elbow flexion/extension and forearm supination/pronation. The wrist provides the flexion/extension and radial/ulnar deviation.

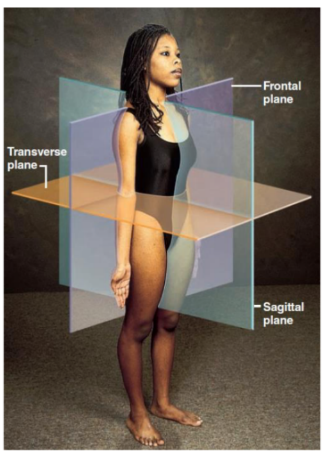


Figure 1. Standard anatomical posture with major movements

Degrees of freedom	Movement range
Shoulder flexion/extension	150°-180°/40°-50°
Shoulder abduction/adduction	180°/30°-40°
Shoulder internal/external rotation	70°-95°/40°-70°
Elbow flexion/extension	135°-1400/0°
Forearm supination/pronation	85°-90°/70°-90°
Wrist flexion/extension	73°/70°
Wrist radial deviation/ulnar deviation	27°/27°

Table 1. The movement range of each degree of freedom (DOF)

2. Upper limb as a biomechanism

The upper limb is an open kinematic chain starting in the sternoclavicular joint and ending in finger joints. Due to the specific structure of human joints, only rotational motions in these joints are possible. In case of structural analysis of the limb as the bio mechanism, individual bones are considered as movable parts, and their joints as kinematic pairs of different classes (class III-3 degrees of freedom etc.)

Conclusions/action items:

The human upper limb is a complicated system of bones, joints, muscles and other elements. Its structure allows to perform the set of movements essential in daily activities. The girl that we are helping this year has severe muscle weakness in her upper limb, however, she has great shoulder control, which is a cutting point of our design that we could possible use her shoulder to aid her arm movements.

2010/1/29 Upper Limb Disability Assistive Design

Camille Duan - Jan 30, 202

Title: Upper Limb Disability Assistive Design

Date: 1.29.2020

Content by: Camille

Present: Camille

Goals: To research on different design to help with upper limb disability

Content:

Reference: <Access Library Resource. (n.d.). Retrieved from https://ieeexplore-ieee-org.ezproxy.library.wisc.edu/search/searchresult.jsp?searchWithin=%22Publication%20Number%22:5305883&searchWithin=%22Document%20Title%22:Assistive%20device%20for%20people%20with%20upper%20limb

Techno-aid center in Nagasaki University is developing assistive dives for the elderly and is providing them to the people with disability based on the requests from the eld disabled.

An assistive device with two electric motors was then designed. Features of this device are to resist gravity by using one motor and to bend the elbow joint by using the oth assistive device is designed to assist the people with upper limb disability to enjoy having meals, drawing, and operating computer. It is important idea that it is designed to movements of human's arm and not to restrict the freedoms of movements.

A feature of the prototype is that user can move his arm freely in the horizontal direction. Only movement of the arm in the horizontal direction is assisted by the electric m problem of the device is that the free working range in the horizontal direction is narrowly limited.

Figure 1. Device Prototype Picture

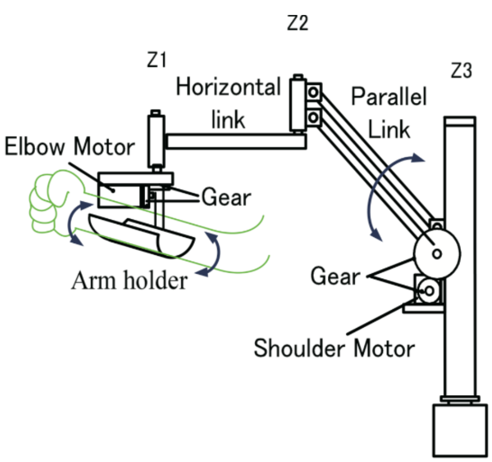


Figure 2. Detail of proposed design

Conclusions/action items:

2019/1/27 Arm Support Design

Camille Duan - Feb 24, 2020, 9:43 PM CST

Title: Arm Support Design

Date: 1.27.2020

Content by: Camille

Present: Camille

Goals: To come up with an arm support system design idea

Content:

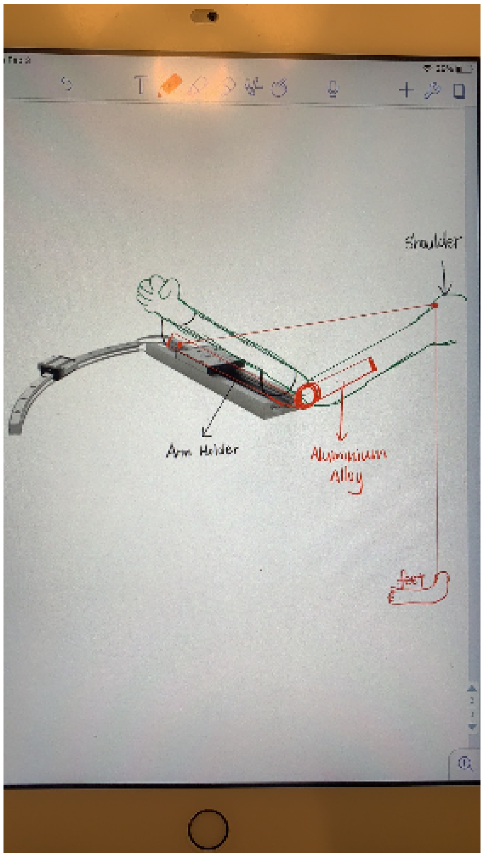


Figure 1. Arm support system attached with wheelchair

- The Arm can move in the transverse plane and sagital plane
- Glider system was added so that it can move in the transverse plane with shoulder control
- Artificial Joint can be attached the the entire upper limb with straps on, so that it can apply force at two points and the lower limb can move by shortening the string using one feet

Conclusions/action items:

This design unitizes a wheelchair as a platform so that the rail glides can be attached on. This design also utilizes the shoulder movement of the little girl to help her arm move back and forth. One of her feet can move up and down without the assistance from an adult so that I added design for her feet to pull the string so that the arm could move up and down.

2020/2/4 Backpack Design Idea

Camille Duan - Feb 24, 2020, 10:03 PM CST

Title: Backpack Design Idea

Date: 2020.2.4

Content by: Camille

Present: Camille

Goals: To make a portable design so that the girl could play at the table and on the ground

Content:

Figure 1. Portable backpack design

- Adjustable PVC pipes are added on one side of the backpack
- Elastic bands are hanging at the end of the PVC pipes

Advantages

- Can be easily carried around
- Able to adjust height
- Lightweight and comfortable
- Easy to fabricate

Disadvantage

- Unable to stabilize at one fixed location

Conclusions/action items:

This design has the issue of balance. The weight of the PVC pipes could tilt the backpack over.

2020/2/20 Floor Sliding Design

Camille Duan - Feb 24, 2020, 10:18 PM CST

Title: Floor Sliding Design

Date: 2020.2.20

Content by: Camille

Present: Camille

Goals: Combine old design to fulfill client requirements

Content:

Figure 1. PVC pipe floor design

- New design will add a curved glide rail in the front to add balance
- The guide rail will allow temporally arm rest at a fixed location

Conclusions/action items:

The main component of this design is made of PVC, which is a light material and can be easily carried around. The guide rail would allow arms to rest at a fixed location so that she could possibly play tablets or work on game pieces without bending her back since her muscles in the back are weak.

2018/03/08 Green pass

Camille Duan - Dec 10, 2018, 1:34 AM CST

Title: Green pass

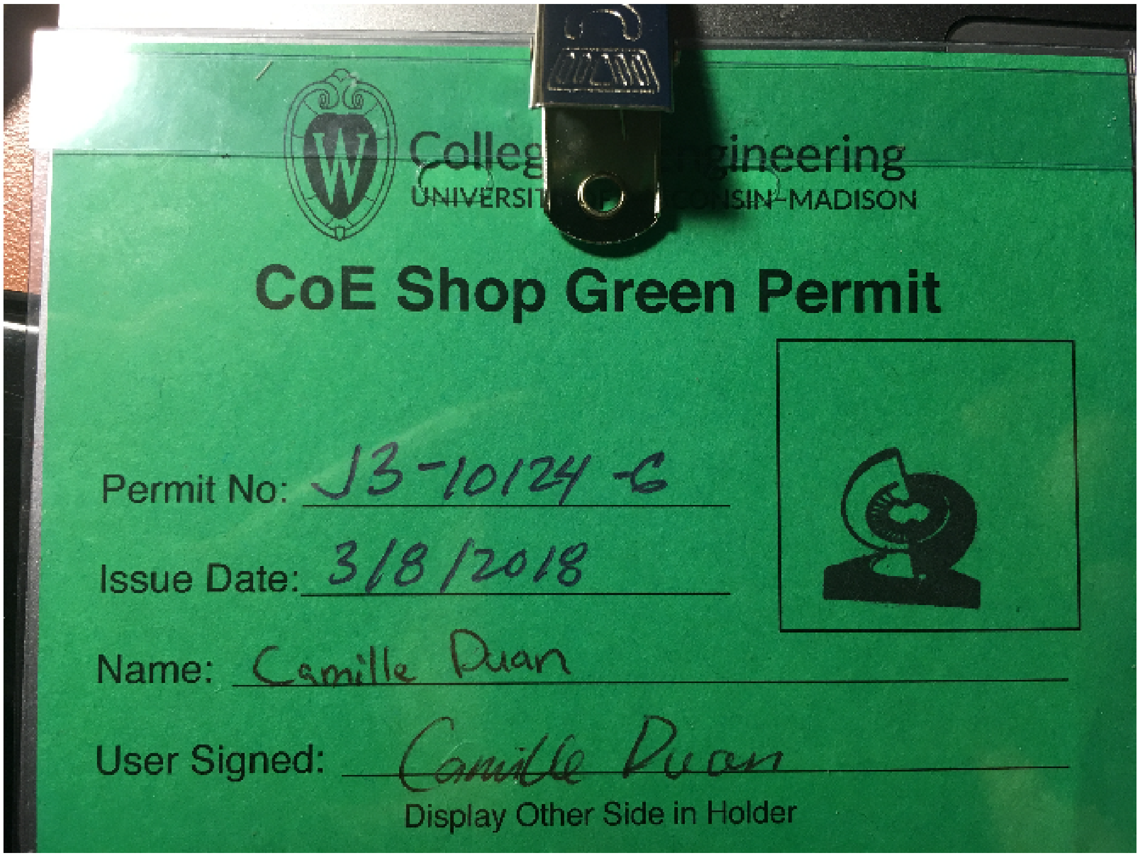
Date: 2018.03.08

Content by: Camille Duan

Present: Camille

Goals: To complete my green pass

Content:



Conclusions/action items:

I complete my training for green pass by making an alpha part. I was on the lathe and mill in total of 7 hours. I learned a lot in the process and mastered how to correctly use mill and lathe. Since I have my green pass now, I will be able to help my team member to fabricate our final design project. We might need help since our design is hard to fabricate and might require other use of machines that we do not have access to yet. We might also change the fabrication plan to make it easier so that we are able to do it by ourselves.

2018/3/20 Animal Contact/ Biosafety Training

Camille Duan - Feb 26, 2019, 9:08 PM CST

Title: Animal Contact/ Biosafety Training

Date: 2018/3/20

Content by: Camille Duan

Present: Camille Duan

Goals: To compete training for research

Content:

University of Wisconsin-Madison

This certifies that CAMILLE DUAN has completed training for the following course(s):

Curriculum	Group Name	Completion Date	Expiration Date
Animal Contact Personnel Quiz	Safety for Personnel with Animal Contact	3/20/2018	
Biosafety 107 Centrifuge Safety Quiz	Biosafety 107: Centrifuge Safety	3/20/2018	
Biosafety Required Training Quiz	Biosafety Required Training	3/10/2018	
Bloodborne Pathogens Safety in Research	Biosafety 102: Bloodborne Pathogens for Laboratory and Research	3/20/2018	

Data Effective: Wed Mar 21 9:01:59 2018
Report Generated: Wed Mar 21 16:43:47 2018

Conclusions/action items:

I have competed all those quiz above for oncology research with possibly using mice to locate abnormal or tumor tissue.

2019/2/20 CITI training

Camille Duan - Feb 26, 2019, 9:05 PM CST

Title: CITI training

Date: 2/20/2019

Content by: Camille Duan

Present: Camille

Goals: To complete CITI training

Content:

Attached is the CITI certificate that I completed for biomedical research with human subjects.

Conclusions/action items:

Camille Duan has a Human Subjects Research certification for conducting biomedical research with human subjects.

Camille Duan - Feb 26, 2019, 9:02 PM CST


CITI PROGRAM

Camille DUAN

UW Biomedical Course

1 - Basic Course

University of Wisconsin - Madison

CITI

citiCompletionReport7930587.pdf(409.7 KB) - download

2020/01/26 Shoulder, Elbow, Wrist Motion

Maggie Zhou - Jan 26, 2020, 10:09 AM CST

Title: Physiology for elbow and wrist

Date: 2020/01/26

Content by: Maggie

Present: /

Goals: Research on the elbow and wrist physiology and anatomy

Content:

The humerus is the single bone of the upper arm region. It articulates with the radius and ulna bones of the forearm to form the elbow joint. The distal end of the humerus has two articulation areas, which join the ulna and radius bones of the forearm to form the elbow joint.

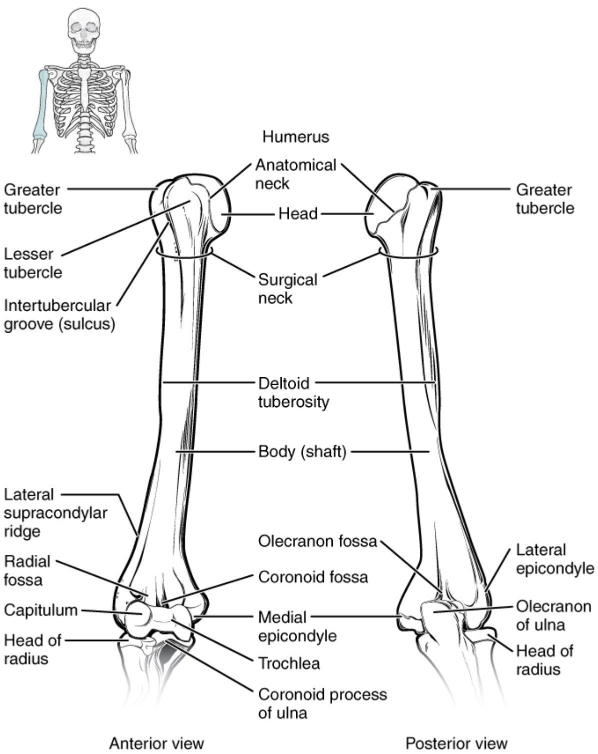


Figure 1. General structure for humerus and elbow

The eight carpal bones form the base of the hand. These are arranged into proximal and distal rows of four bones each. The metacarpal bones form the palm of the hand. The thumb and fingers consist of the phalanx bones.

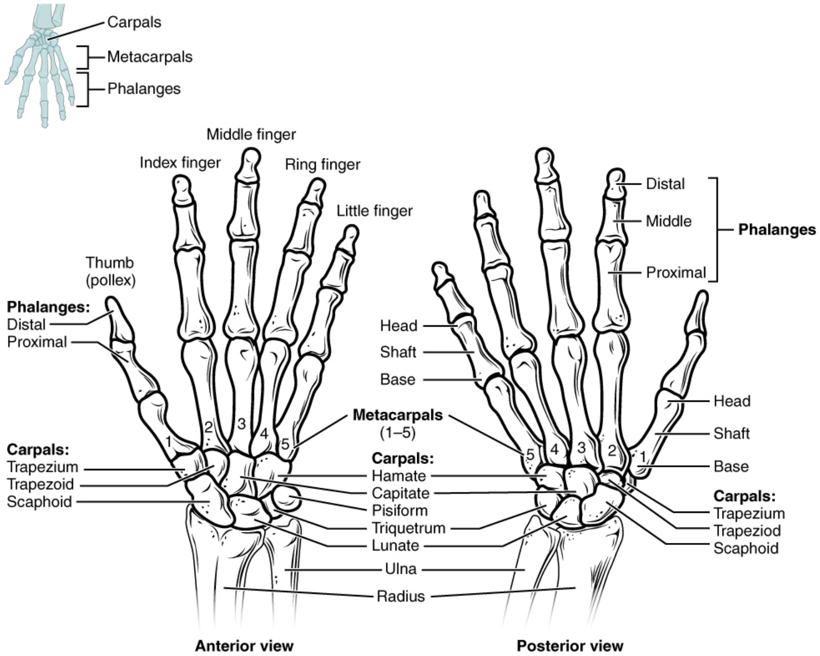


Figure 2. Wrist joint

Conclusions/action items:

From the anatomy and structure for elbow and wrist joint, we found that with only motion with the shoulder joint is not able to be performed without the help of elbow joint and wrist joint. Our design would have to fabricate a system that could help to unify all three of the joints to perform the regular daily routine for the kids. More research needed to be done on the muscle involved in the shoulder, elbow and wrist joint and the potential reason that cause the disfunctionability of elbow and wrist joint.

2020/01/26 Reference Design for Universal Arm Support

Maggie Zhou - Jan 26, 2020, 9:51 AM CST

Title: Reference Design of Universal Arm Support

Date: 2020/01/26

Content by: Maggie

Present: /

Goals: Understand the reference design provided by the client to better understand the project

Content:

Reference: https://www.instructables.com/id/Linear-Glide-Arm-Trough-for-Children-with-Cerebral/

Problem Statement

Some kids with upper extremity limitations have difficulty using a tablet. This may be because they cannot keep their forearms off the tablet surface or do not have adequate strength to slide their arms on the table surface. We were asked to design and fabricate a simple arm trough that supports the forearm and allow adequate range of motion to use a tablet or other table-mounted device.

Design Parameters

The device should be able to cradle the user's arm while allowing them to move their arm linearly and have a full 360 degrees of rotation. This range of motion will allow the user to operate a tablet with greater ease of use. The device should also be comfortable to the user, simple to use, and easy assemble.

(I was unable to add any type of picture during this research day due to labarchive's problem, but I will try later if I could add more pictures of the sample design.)

Conclusion:

The reference design provides us an idea of some potential solution to this problem. Basically kids are unable to move their arms despite the shoulder rotation. Our team needs to fabricate a system of device that could provide motion from 360 degrees that support the elbow and wrist, which could improve the children's life quality so that they could use tablets during their normal life. The reference case focused on providing the kids a motion for tablets, but our client wants the kid to have motion for picking up game pieces, painting or coloring. More sophiscated design is needed.

2020/02/26 Competing Design

Maggie Zhou - Feb 26, 2020, 2:07 PM CST

Title: Competing Design for Arm Holder

Date: 2020/02/26

Content by: Maggie Zhou

Present: /

Goals: Find competing design for arm holder

Content:

https://www.medstore.ie/sonography-chair.html

Figure 1. Sonography Chair

The double articulated ergonomic armrests take the weight of the operators arm and transducer whilst allowing full movement. The saddle chair reduces pressure on the buttocks and thighs whilst encouraging good posture in the lower back. It also allows for easy manoeuvrability around the examination couch and the Sonography Room without the need for continuous standing/sitting. The seat has adjustments for height (by hand and foot), tilt (angle of seat) and uniquely the width can be adjusted as gap and angle of the 2 halves of the seat can be altered. This ensures that the seat is comfortable for all shapes and sizes of operator. SPECIFICATION - Chair Divided seat with adjustable seat width Disinfectable artificial leather (4 colours) Hand controlled seat height adjustment Seat Inclination mechanism Seat Height Range: 56cm - 74cm (other heights available) SPECIFICATION - Ergo Arm Rests 15cm stepless height adjustment Arms swing 360° Extends laterally 25cm Stable and easy-to-use Comfortable forearm pads upholstered in soft leather Strong, light-weight aluminium alloy and polyamide Approved for ESD and clean room class 10 applications Arm is height and fore-aft adjustable and removable. This chair is for the purpose of sonography, however, I do find it application to some purpose of our project, which is to support both arms.

Conclusions/action items:

This design could be an inspiration to our design, despite the fact that this arm supporting system is over the chair and attached to the chair, which we don't want. However, we could simulate something like this or utilize the arm holding pads on this chair since this would be a comfortable choice for the little girl.

2020/02/03 Preliminary Design Idea for Elbow Assistive Device

Maggie Zhou - Feb 03, 2020, 9:05 PM CST

Title: Elbow Assistive Device

Date: 2020/02/03

Content by: Maggie

Present: /

Goals: Establish a general idea of my first preliminary design

Content:

Reference:

https://www.researchgate.net/figure/Schematic-representation-of-the-TSA-structure_fig2_313853836

https://www.shop-orthopedics.com/Breg_T_Scope_Elbow_Premier_Brace_p/0725x.htm?1=1&CartID=0

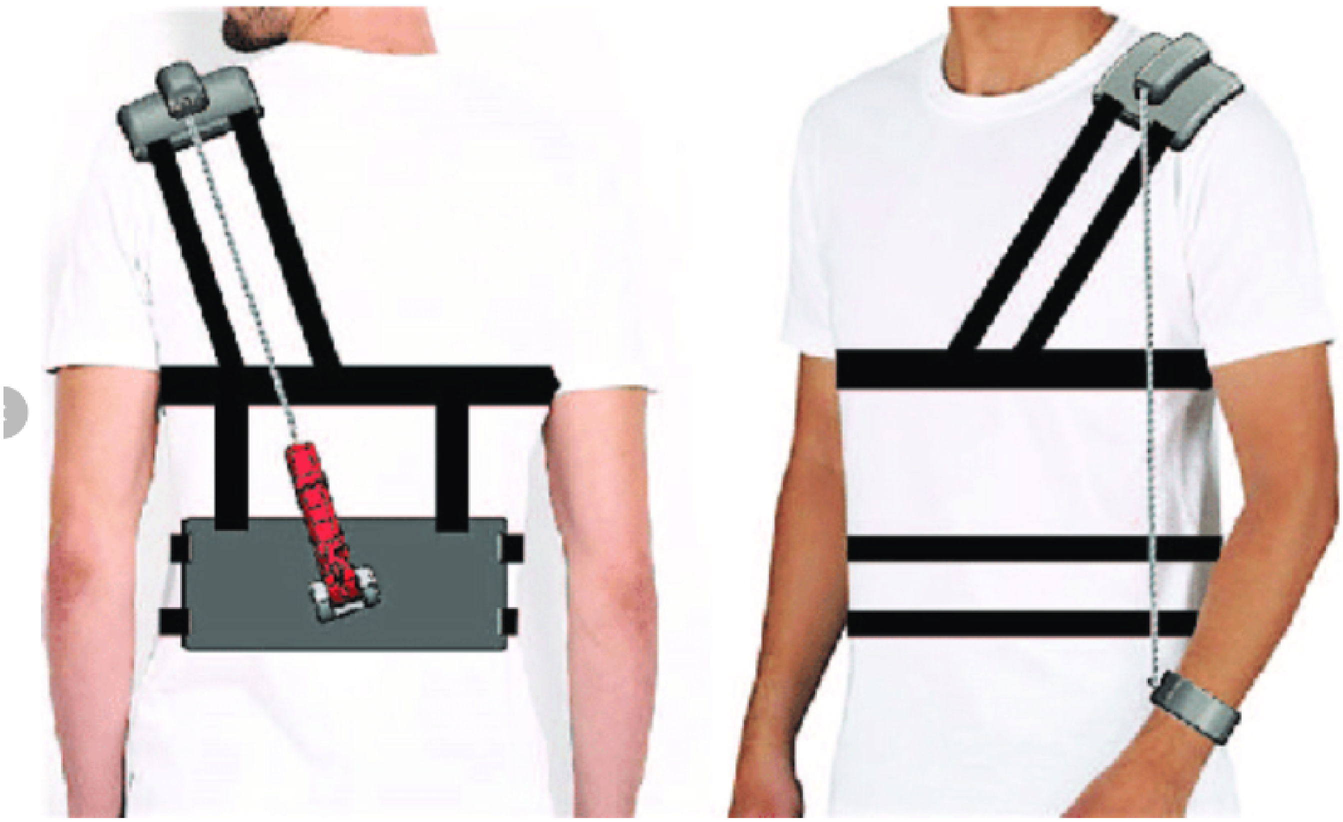


Figure 1. Motor powered elbow assistive device

Figure 2. Elbow stabilization device for forearm ligament injury

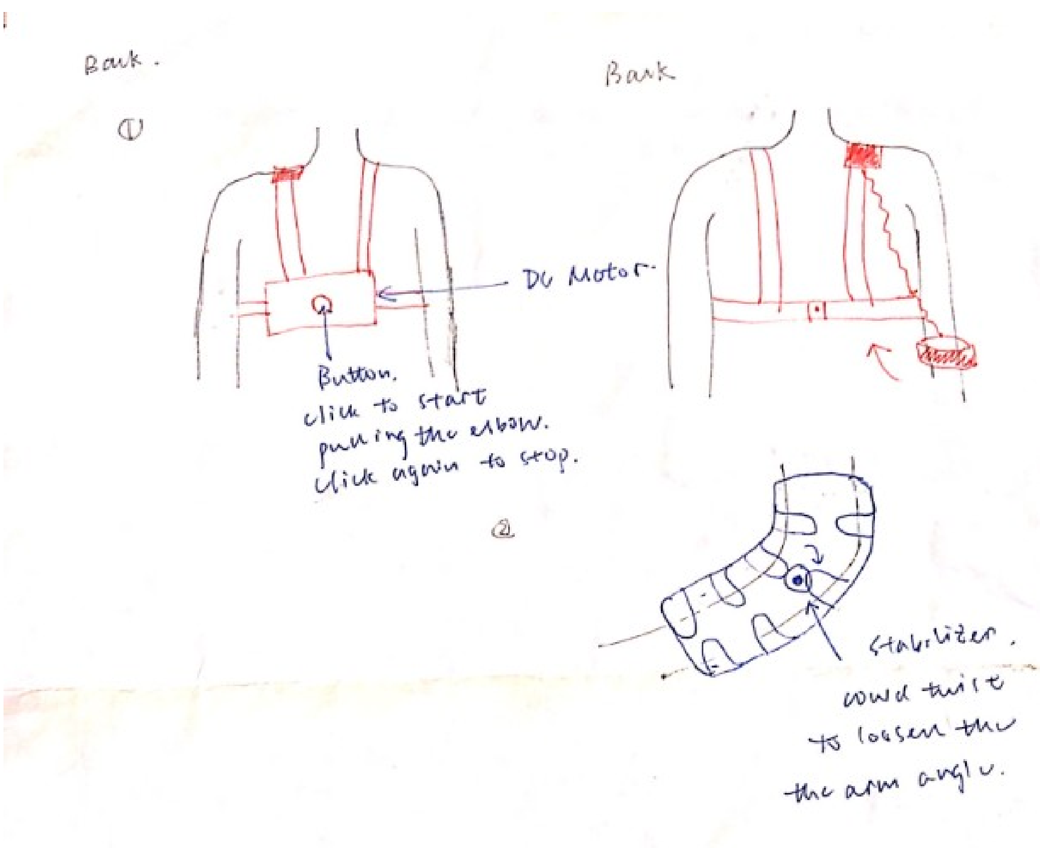


Figure 3. Combination device of motor and elbow stabilization device

This design combines of two parts. First we want to use a simple DC motor to lift our user's elbow and then we are going to use a stabilizer to stabilize the elbow angle in order for the user to perform desired activities.

Conclusions/action items:

This design has a really simple motor which could provide force to the intended motion. However, the motion is not 3-dimensional and also the stabilizer is only able to stable the arm angle in a certain position. It's not able to provide anymore ideal motion. This design could be combined with other teammates' design to see potential feasibility.

2020/02/21 Updated Design

Title: Updated Design for Arm Holder

Date: 2020/02/21

Content by: Maggie

Present: /

Goals: Update the design with new client requirements

Content:

https://www.amazon.com/Posture-Corrector-Teenager-Clothes-Humpback/dp/B07PFGS3V5/ref=asc_df_B07PFGS3V5/?tag=hyprod-20&linkCode=df0&hvadid=343269713726&hvpos=&hvnetw=g&hvrand=12711217498926235236&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9018948&hvtargid=757849942704&psc=1&tag=&ref=&adgrpid=71833457474&hvpone=&hvptwo=&hvadid=343269713726&hvpos=&hvnetw=g&hvrand=12711217498926235236&hvqmt=&hvdev=c&hvdvcmdl=&
757849942704

Figure 1. Sample back vest for children.

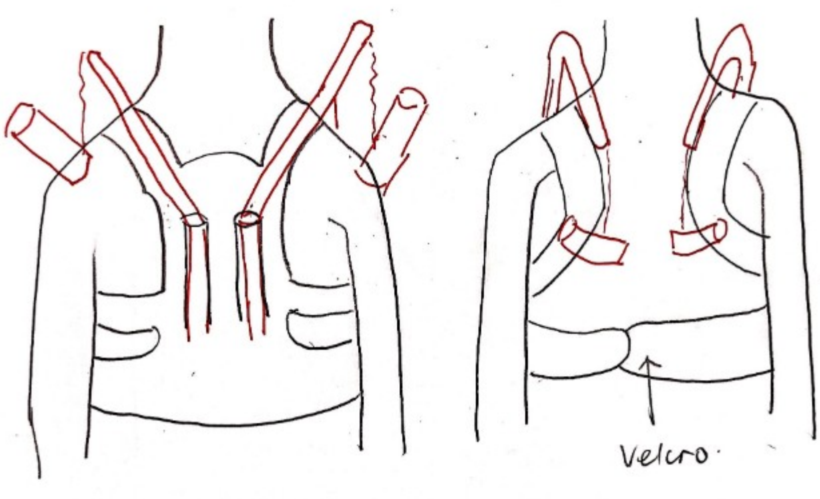


Figure 2. Sample Design for Arm Holder

Conclusions/action items:

The new design is set up for holding the arms as the main purpose with the help of back holding vest for kids. The SMA kids already had a vest potentially, which we need to double check witl add something on to that vest. If not, this vest online is about 8.8 ounces so this wouldn't be a huge burden to the little girl. More research needed to be done on this design about how to set tł want to be.

2020/1/28-Arm Disabilities

James Tang - Mar 01, 2020, 4:04 PM CST

Title: Arm Disabilities

Date: 2020.1.28

Content by: James Tang

Present: James Tang

Goals: Learning the physiologies behind arm disabilities

Content:

How to define arm disabilities?

By the DASH Questionnaire.

What is the DASH Questionnaire and why use it?

The scores are then used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability)—this is called the DASH score. The DASH questionnaire is used as an indicator of the impact of an impairment on the level and type of disability.

DASH Questionnaire copy is included as an attachment.

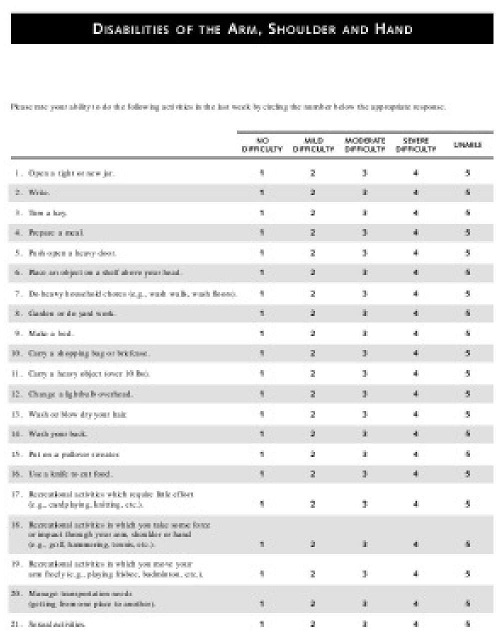
Reference:

1. https://www.myoptumhealthphysicalhealth.com/Documents/Forms/DASH.pdf

Conclusions/action items:

Based on a scoring system, whether the patient has arm disability can be decided.

James Tang - Feb 04, 2020, 4:47 PM CST



DISABILITIES OF THE ARM, SHOULDER AND HAND

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

DASH.pdf(49.5 KB) - download

2020/2/2 MSA Syndromes

Title: MSA Syndromes

Date: 2020/2/2

Content by: James Tang

Present: James Tang

Goals: To learn more background information on SMA and how our client situation is similar to it.

Content:

What is MSA?

Multiple system atrophy (MSA) is a progressive neurodegenerative disorder characterized by a combination of symptoms that affect both the autonomic nervous system (the part of the nervou
progressive loss of function and death of different types of nerve cells in the brain and spinal cord.

Symptoms of autonomic failure that may be seen in MSA include fainting spells and problems with heart rate, erectile dysfunction, and bladder control. Motor impairments (loss of or limited mu
difficulties with speech and gait (the way a person walks). Some of these features are similar to those seen in Parkinson's disease, and early in the disease course it often may be difficult to di

MSA is a rare disease, affecting potentially 15,000 to 50,000 Americans, including men and women and all racial groups. Symptoms tend to appear in a person's 50s and advance rapidly over
often develop pneumonia in the later stages of the disease and may suddenly die from cardiac or respiratory issues.

While some of the symptoms of MSA can be treated with medications, currently there are no drugs that are able to slow disease progression and there is no cure.

MSA includes disorders that historically had been referred to as Shy-Drager syndrome, olivopontocerebellar atrophy, and striatonigral degeneration.

What causes MSA?

The cause of MSA is unknown. The vast majority of cases are sporadic, meaning they occur at random. A distinguishing feature of MSA is the accumulation of the protein alpha-synuclein in gl
type of cell that makes myelin (a coating on nerve cells that lets them conduct electrical signals rapidly). This protein also accumulates in Parkinson's disease, but in nerve cells. Because they
synucleinopathies. A possible risk factor for the disease is variations in the synuclein gene SCNA, which provides instructions for the production of alpha-synuclein.

Symptoms:

Multiple system atrophy (MSA) affects many parts of your body. Symptoms typically develop in adulthood, usually in the 50s or 60s.

MSA is classified into two types: parkinsonian and cerebellar. The type depends on the symptoms you have at diagnosis.

Parkinsonian type

This is the most common type of MSA. The signs and symptoms are similar to those of Parkinson's disease, such as:

- Rigid muscles
- Difficulty bending your arms and legs
- Slow movement (bradykinesia)
- Tremors (rare in MSA compared with classic Parkinson's disease)
- Problems with posture and balance

Cerebellar type

The main signs and symptoms are problems with muscle coordination (ataxia), but others may include:

- Impaired movement and coordination, such as unsteady gait and loss of balance
- Slurred, slow or low-volume speech (dysarthria)
- Visual disturbances, such as blurred or double vision and difficulty focusing your eyes
- Difficulty swallowing (dysphagia) or chewing

General signs and symptoms

In addition, the primary sign of multiple system atrophy is:

- Postural (orthostatic) hypotension, a form of low blood pressure that makes you feel dizzy or lightheaded, or even faint, when you stand up from sitting or lying down

You also can develop dangerously high blood pressure levels while lying down.

MSA might cause other difficulties with involuntary (autonomic) body functions, including:

-Urinary and bowel dysfunction

- Constipation
- Loss of bladder or bowel control (incontinence)

-Sweating abnormalities

- Reduced production of sweat, tears and saliva
- Heat intolerance due to reduced sweating
- Impaired body temperature control, often causing cold hands or feet

-Sleep disorders

- Agitated sleep due to "acting out" dreams
- Abnormal breathing at night

-Sexual dysfunction

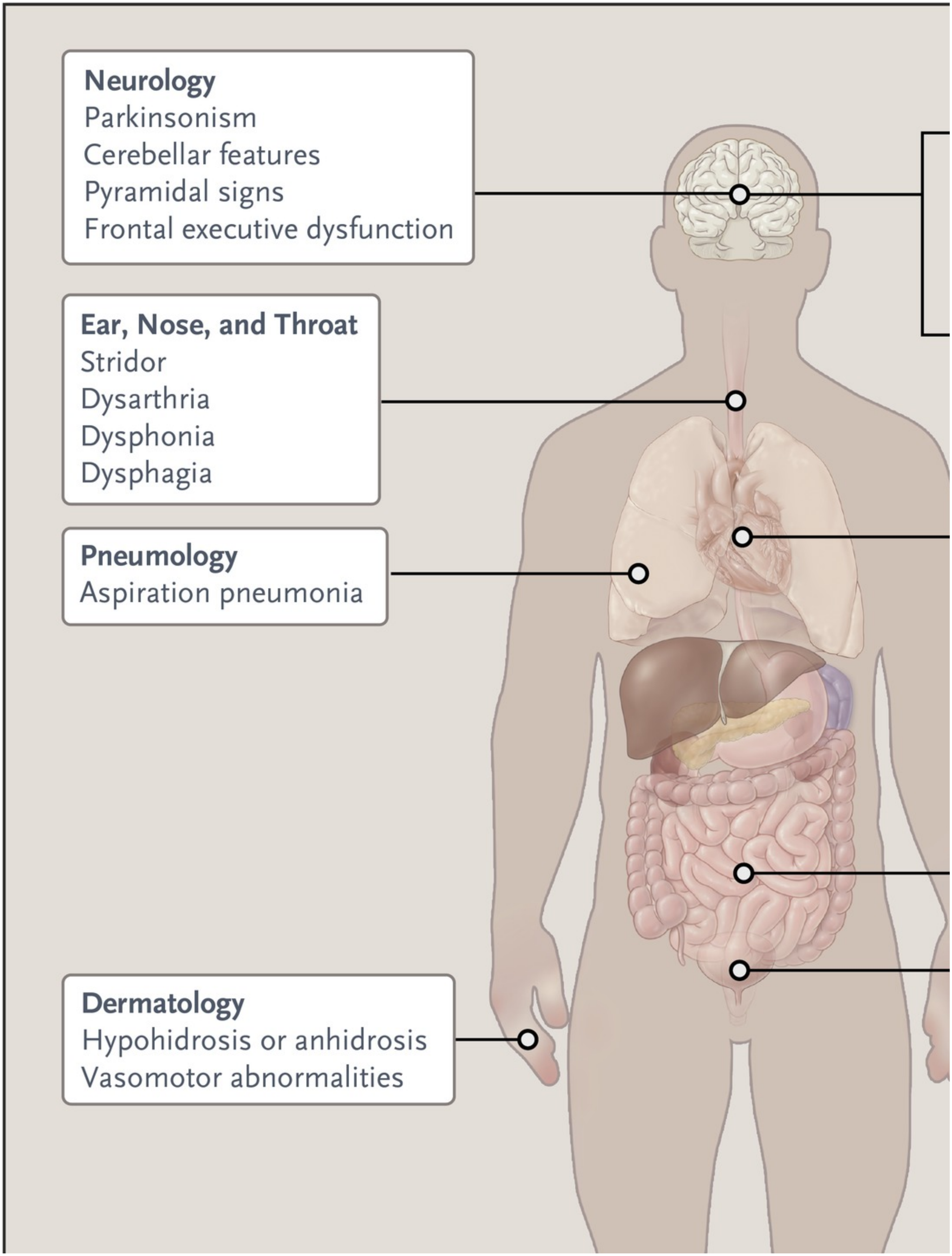
- Inability to achieve or maintain an erection (impotence)
- Loss of libido

-Cardiovascular problems

- Irregular heartbeat

-Psychiatric problems

- Difficulty controlling emotions, such as laughing or crying inappropriately



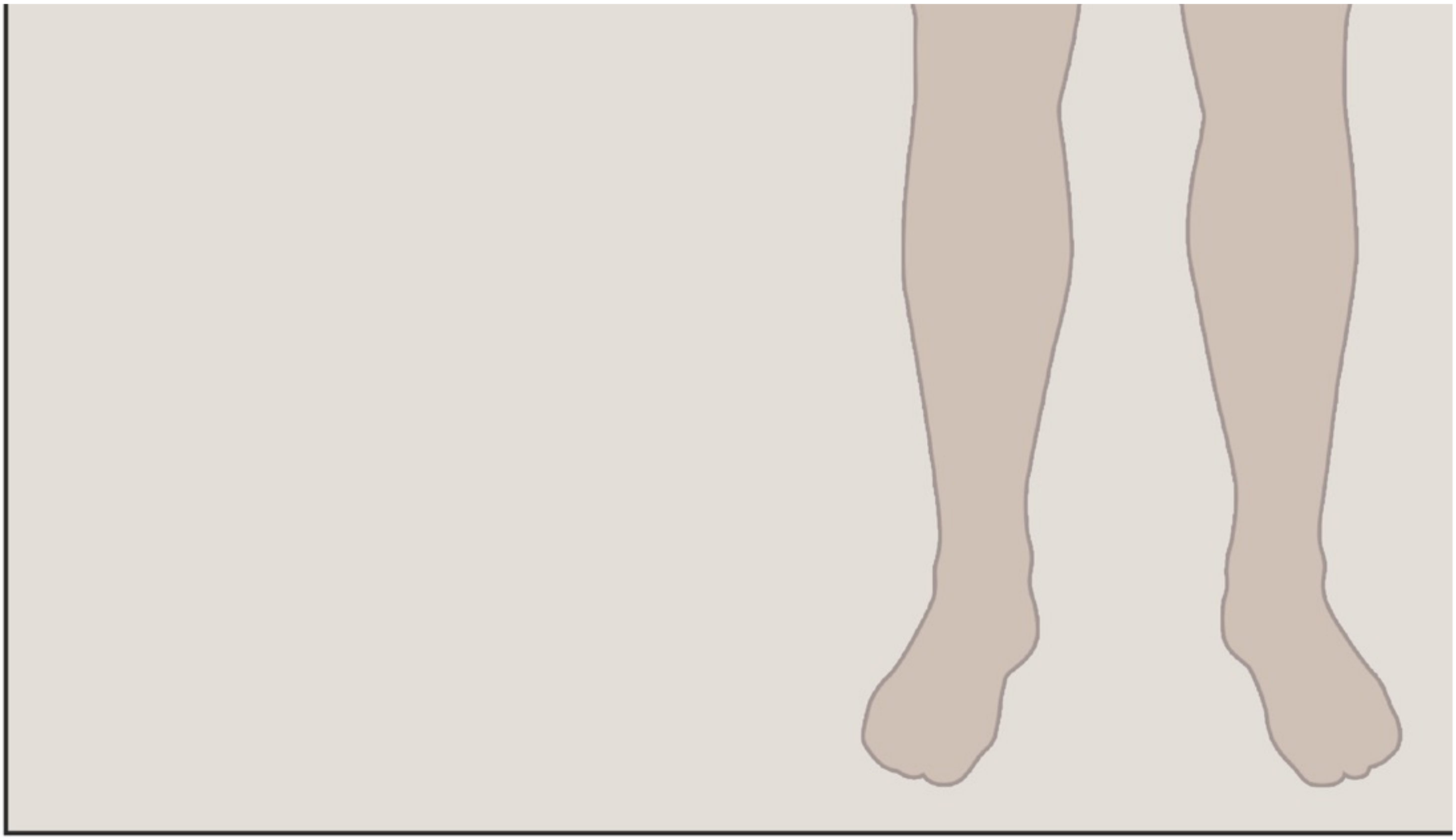


Figure 1. Multidisciplinary Presentation of MSA.

Reference:

1. Fanciulli, A., & Wenning, G. K. (2015). Multiple-system atrophy. *New England Journal of Medicine*, *372*(3), 249-263.

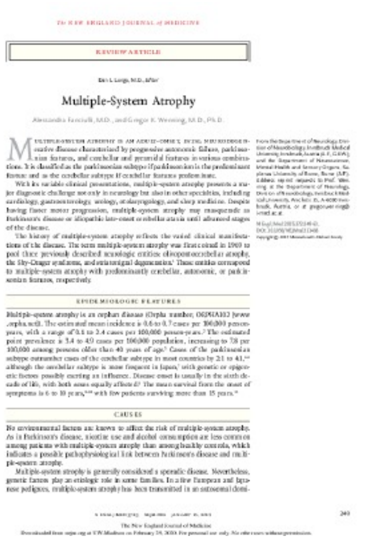
2. https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Multiple-System-Atrophy

3. https://www.mayoclinic.org/diseases-conditions/multiple-system-atrophy/symptoms-causes/syc-20356153

Conclusions/action items:

Currently, there are no treatments to delay the progressive neurodegeneration of MSA, and there is no cure. There are treatments to help people cope with the symptoms of MSA. So it could be very challeng

James Tang - Feb 29, 2020, 4:52 PM CST



REVIEW ARTICLE

Multiple-System Atrophy

EPIDEMIOLOGIC FEATURES

CAUSES

Multiple-System_Atrophy.pdf(1.5 MB) - download

2020/2/10 How to mind-control a robot?

James Tang - Mar 01, 2020, 4:16 PM CST

Title: How to mind-control a robot?

Date: 2020/2/10

Content by: James Tang

Present: James

Goals: Since I want to design a mind-controlled power arm for the client, I would like to know if it is feasible. If so, what sort of knowledge and technology I need in order to make it happen.

Content:

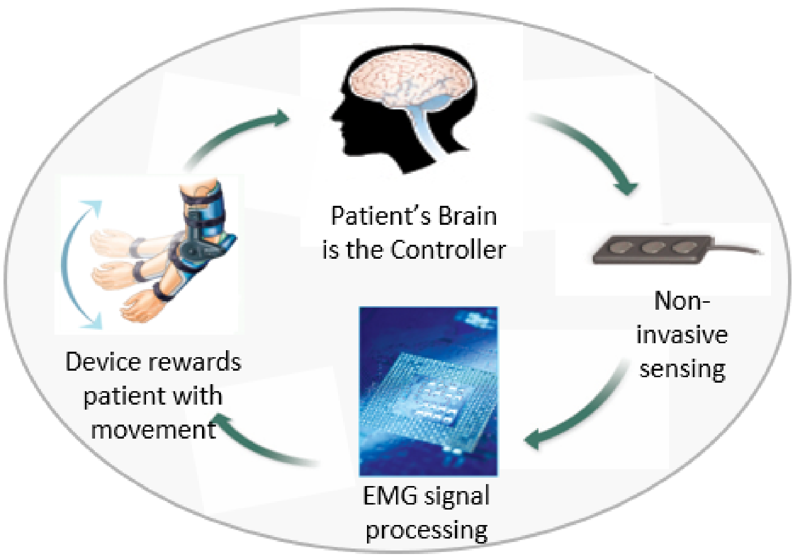


Figure 1: A brief process of how the brain can control an arm brace.

Non-invasive Sensor

Chemical Sensors/biosensors

The International Union of Pure and Applied Chemistry defines a chemical sensor as: “a device that transforms chemical information, ranging from the concentration of a specific sample component to total composition analysis, into an analytically useful signal.” A typical chemical sensor contains two basic functional units: a receptor and a physico-chemical transducer. If the receptor consists of a biological component (e.g., enzyme, antibody, DNA etc), the device is known as a biosensor. The receptor transforms the analyte concentration into a chemical or physical output signal with a defined sensitivity. The main role of the receptor is to provide high selectivity towards the desired analyte in the presence of potentially interfering chemical species. The receptors thus help in obviating false-positive results. The transducer is another crucial component of the sensor that serves to convert the signal generated by the receptor–analyte interaction to a readable value. Biosensors can be distinguished based on their receptors, as either catalytic or affinity-based. Similarly, they can be classified according to the type of transducer used as electrochemical, optical, piezoelectric, and calorimetric sensors.

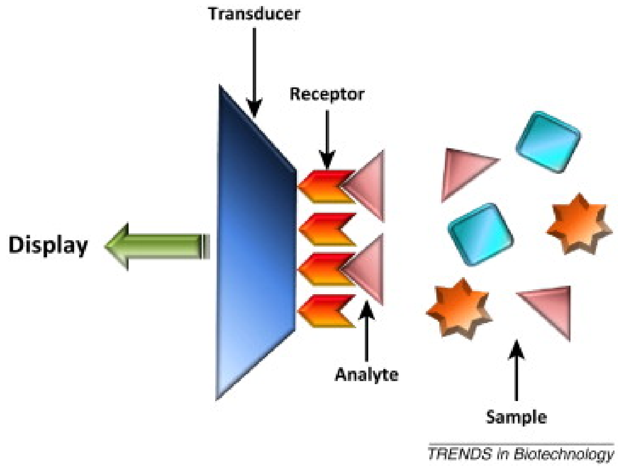


Figure 2: Schematic showing important components of a typical sensor.

Wearable non-invasive electrochemical biosensors

Similar to their *in vitro* counterparts, wearable non-invasive electrochemical sensors can detect target analytes in tears, saliva, sweat, and skin interstitial fluid. Researchers have recently made considerable efforts to develop wearable chemical sensors that can conveniently monitor these biofluids.

Table 1. Selected wearable salivary electrochemical sensors

Platform[a]	**Biofluid**	**Recognition element**	**Technique**	**Analyte**	**Refs**
Denture	Saliva	Glass membrane	Potentiometry	pH	[9]
Partial chrome-cobalt denture	Saliva	Lanthanum fluoride	Potentiometry	Fluoride	[10]
Mouthguard	Saliva	Lactate oxidase	Amperometry	Lactate	[12]
Graphene on silk	Saliva	Peptides	Resistometry	*Staphylococcus aureus*	[13]
Polytetrafluoroethylene	Tears	Bare gold	Conductometry	Electrolytes	[18]
Gas-permeable membrane	Tears	Bare platinum	Amperometry	Oxygen	[19]
Polypropylene	Tears	GOx	Amperometry	Glucose	[21]
Polyimide	Tears	GOx	Amperometry	Norepinephrine and glucose	[23]
PET contact lens	Tears	GOx	Amperometry	Glucose	24, 25, 26
PET contact lens	Tears	Lactate oxidase	Amperometry	Lactate	[28]
Cotton (underwear)	Sweat	Bare carbon	Amperometry	β-nicotinamide adenine dinucleotide and hydrogen peroxide	[41]
Polyimide/Lycra blend	Sweat	Sodium ionophore	Potentiometry	Sodium	[43]
Cotton yarn	Sweat	Hydrogen, ammonia, and potassium ionophore	Potentiometry	pH, ammonium, and potassium	[45]
Polyester	Sweat	Ag/AgCl	Potentiometry	Chloride	[46]
Gas-permeable membrane	Sweat	Platinum	Amperometry	Oxygen	[47]
Elastomeric stamps	Sweat	Bare carbon	Voltammetry	Uric acid	[49]
Temporary tattoo	Sweat	Lactate oxidase	Amperometry	Lactate	[50]
Temporary tattoo	Sweat	Polyaniline	Potentiometry	pH	[51]
Temporary tattoo	Sweat	Ammonium ionophore	Potentiometry	Ammonium	[52]
Temporary tattoo	Sweat	Sodium ionophore	Potentiometry	Sodium	[53]
Parylene skin patch	Sweat	Lactate oxidase	Conductometry	Lactate	[54]

Abbreviations: GOx, glucose oxidase enzyme; PET, polyethylene terephthalate.

Reference:

1. Al-Ali, A. (2013). *U.S. Patent No. 8,418,524*. Washington, DC: U.S. Patent and Trademark Office.
2. Bandodkar, A. J., & Wang, J. (2014). Non-invasive wearable electrochemical sensors: a review. *Trends in biotechnology*, *32*(7), 363-371.
3. Al-Ali, A. (2014). *U.S. Patent No. 8,720,249*. Washington, DC: U.S. Patent and Trademark Office.
4. Khalil, O. S., De Mul, F. F., Hanna, C. F., Stalder, A. F., Yeh, S. J., Wu, X., ... & Bolt, R. A. (2003). *U.S. Patent No. 6,662,030*. Washington, DC: U.S. Patent and Trademark Office.

Conclusions/action items:

Wearable non-invasive electrochemical sensors can detect target analytes in tears, saliva, sweat, and skin interstitial fluid. Researchers have recently made considerable efforts to develop wearable chemical sensors that can conveniently monitor these biofluids.

2020/2/20 4-Year-Old Girl Limb Size

James Tang - Mar 01, 2020, 4:25 PM CST

Title: 4-Year-Old girl arm size

Date: 2020/2/20

Content by: James Tang

Present: James

Goals: Since we have not had a chance to meet the patient or we could take measurements on her, I need to make an assumption on her size.

Content:

Age cohort (years)	N	$\overline{X}$	SD	SE	95% CI L Bound	95% CI U Bound	Min	Max	CV
Females	2,591								
3	39	432	21.2	3.5	425	439	376	468	4.91
4	62	463*	21.8	2.8	458	470	411	526	4.71
5	97	495**	25.6	2.6	490	500	430	567	5.17
6	114	521	26.5	2.5	516	526	445	587	5.07
7	175	561	29.6	2.2	557	566	496	641	5.27
8	143	589	33.3	2.8	583	595	495	690	5.66
9	179	612**	33.3	2.5	607	617	524	717	5.45
10	161	649	34.5	2.7	643	654	557	761	5.32
11	208	681	37.1	2.6	676	686	580	763	5.45
12	181	705	36.8	2.7	700	711	614	817	5.23
13	189	725***	33.8	2.5	720	730	642	808	4.67
14	209	738***	29.6	2.1	734	742	668	827	4.02
15	259	739***	34.2	2.1	735	744	638	852	4.63
16	227	739***	33.0	2.2	734	743	634	839	4.46
17	183	736***	31.2	2.3	731	740	632	800	4.25
18	165	735***	34.7	2.7	730	740	640	828	4.72
Males	2,564								
3	47	431	23.1	3.4	425	438	381	484	5.36
4	90	472	20.6	2.2	468	476	425	523	4.36
5	119	506	24.9	2.3	501	510	438	557	4.93
6	112	527	25.6	2.4	522	532	459	613	4.85
7	191	567	29.8	2.2	562	571	500	658	5.26
8	153	593	32.6	2.6	588	598	504	698	5.49
9	177	623	32.6	2.4	618	628	502	722	5.23
10	182	643	30.4	2.3	639	648	580	748	4.73
11	225	674	36.9	2.5	669	679	586	772	5.47
12	213	709	45.3	3.1	703	715	606	849	6.40
13	217	738	42.3	2.9	732	743	646	885	5.73
14	225	776	37.4	2.5	771	781	687	869	4.82
15	198	795	34.0	2.4	790	800	702	894	4.28
16	145	815	39.6	3.3	808	821	718	944	4.85
17	155	812	35.1	2.8	807	818	717	903	4.32
18	115	810	33.8	3.2	804	817	735	909	4.17

Significant difference between males and females obtained using ANOVA:
* $p \le 0.05$, ** $p \le 0.01$, *** $p \le 0.001$

Figure 1: ARM LENGTH (IN MM) BY SEX AND AGE.

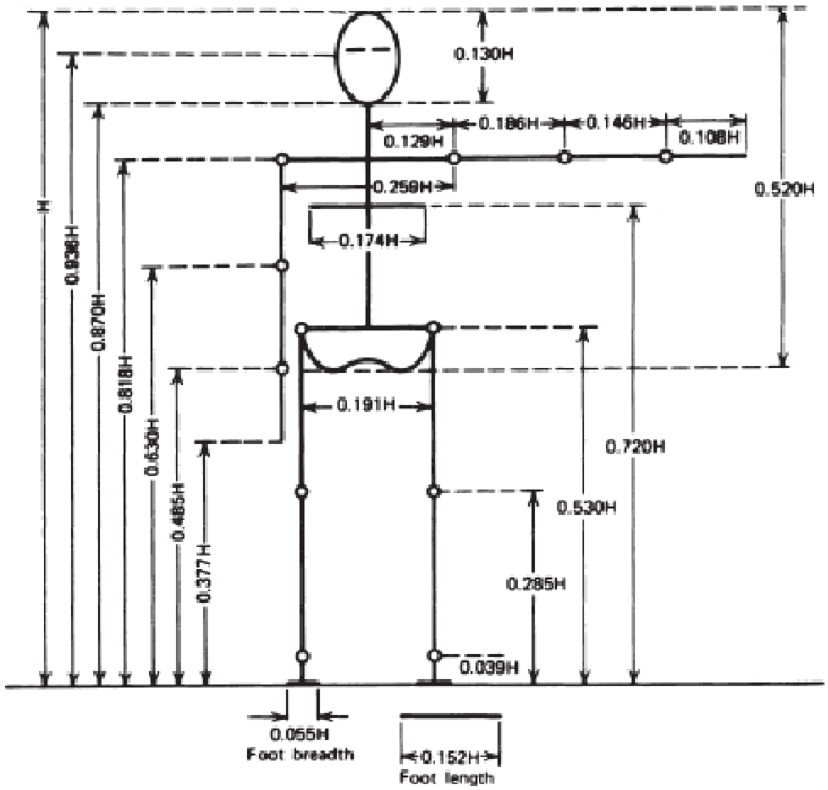


Figure 2: Anthropometric segment length of human body as a function of body height (Winter, 2009).

1. Karimi, G., & Jahanian, O. (2012). Genetic algorithm application in swing phase optimization of AK prosthesis with passive dynamics and biomechanics considerations. *Genetic Algorithms in Applications*, 71.
2. Živičnjak, M., Smolej Narančić, N., Szirovicza, L., Franke, D., Hrenović, J., & Bišof, V. (2003). Gender-specific growth patterns for stature, sitting height and limbs length in Croatian children and youth (3 to 18 years of age). *Collegium antropologicum*, *27*(1), 321-334.

Conclusions/action items:

Based on these research, my estimation of the girl's arm length would be 46.3 CM.

2020/2/3 Jaeco Elevating MultiLink Mobile Arm Support

James Tang - Feb 29, 2020, 5:28 PM CST

Title: Jaeco Elevating MultiLink Mobile Arm Support

Date: 2020/2/3

Content by: James Tang

Present: James Tang

Goals: Explore current existing competing designs, and to brainstorm a better design or cheaper than it.

Content:

Introduction:

Jaeco Elevating MultiLink Mobile Arm Support has an addition of an elevation assist to the multilink which significantly allows greater range of motion for feeding and facial hygeine. This new design has more lifting power with fewer rubber bands.

Features:

- Jaeco Elevating MultiLink Mobile Arm Support requires minimal tools for set-up and client adjustment
- 20" Standard will fit most clients
- 24" long elevating is for clients over 6ft 2" in height or when one of the power chair mount relocators cannot be used and attachment point for chair mount is behind the patient's shoulder

Price:

$828.99

Figure 1: Jaeco Elevating MultiLink Mobile Arm Support.

Advantages:

- has an addition of an elevation assist to the multilink which significantly allows greater range of motion for feeding and facial hygeine.
- has more lifting power with fewer rubber bands.

Disadvantages:

- Expensive
- has no kids size
- Fixed with the table

Conclusions/action items:

This is a very common design with no outstanding advantages, we can make something better than this especially for a little girl.

2020/2/4 Suspension Mobile Arm Support

James Tang - Feb 29, 2020, 5:28 PM CST

Title: Suspension Mobile Arm Support

Date: 2020/2/4

Content by: James Tang

Present: James Tang

Goals: Explore current existing competing designs, and to brainstorm a better design or cheaper than it.

Content:

Introduction:

The Suspension Arm Sling has an adjustable balance bar and spring to allow for the best possible user function. The sling is lined with soft leather and can be used on the left or right arm; one size fits most. The Suspension Arm Sling's elbow and wrist cuffs are assembled with latex-based glue. Use the Suspension Arm Sling with the Folding Arm Sling Frame or Suspension Rod. Replacement Wrist Hand Supports for both the right and left wrist are available for purchase separately.

Features:

- Brings hardware overhead to allow for walls and objects around the wheelchair
- Ensures rotation occurs at the side of the arm at the ball bearing joint
- Minimal tool assembly requirement allows for quick set-up
- Positions the arm to be closer to the center of gravity
- Designed for optimum comfort and durability

Price:

$147.8

Figure 1: Suspension Mobile Arm Support.

Advantages:

- Brings hardware overhead to allow for walls and objects around the wheelchair
- Ensures rotation occurs at the side of the arm at the ball bearing joint
- Minimal tool assembly requirement allows for quick set-up
- Positions the arm to be closer to the center of gravity
- Designed for optimum comfort and durability
- Low price

Disadvantages:

- has no kids size
- Fixed with the wheelchair.

Conclusions/action items:

This is a very good design we can try to improve, we can make a similar product but designated for the little girl.

Power Arm Design Idea

James Tang - Feb 29, 2020, 4:58 PM CST

Title: Mind-controlled Exoskeleton

Date: 2/12/20

Content by: James Tang

Present: James Tang

Goals: Show my design idea after brainstorming and digging into the client's situation.

Content:

What is my design?

Mind-controlled Exoskeleton

The third design that came up from the team is called Mind-controlled Exoskeleton. The mind-controlled exoskeleton is a powered arm and hand orthosis (brace) designed to help restore function to upper extremities paralyzed or weakened by neuromuscular and neurological disease or injury. The mind-controlled exoskeleton works by reading the faint nerve signals (myoelectric signals) from the surface of the skin (no implants) then activating small motors to move the limb as the user intends (no electrical stimulation).

The user is completely controlling their own hand, wrist, elbow, and arm; the robotic arm brace amplifies weak muscle signals to help move the upper limb. The dimension is designed specifically for a 4-year-old girl [10]. Its functioning process starts from the patient's brain which decides the moves, and then it sends signals to the non-invasive sensing system. Afterward, the EMG signal processing system will read the signals sent from the brain and command the device to perform the move.

More importantly, the mind-controlled exoskeleton is a wearable robotic device on the market to help restore function for those who still have their arms and hands but are unable to use them.

Conceptual Image:

Figure 1. Mind-controlled Exoskeleton to support arm motion with signals sent from the brain. It consists of a non-invasive sensing system and an EMG signal processing system.

Conclusions/action items:

This design is a well-built machine and is supposed to be highly accurate and stable. However, it requires complicated building techniques or calculations or advanced technologies. Also, the overall perspective cost is way beyond the budget.

Crazy Design Idea!!!!

James Tang - May 01, 2020, 3:43 PM CDT

Title: Crazy Design Idea

Date: 3/30/20

Content by: James Tang

Present: James Tang

Goals: Thinking about a crazy design idea that might not be feasible but interesting.

Content:

What is my design?

A robotic suit.

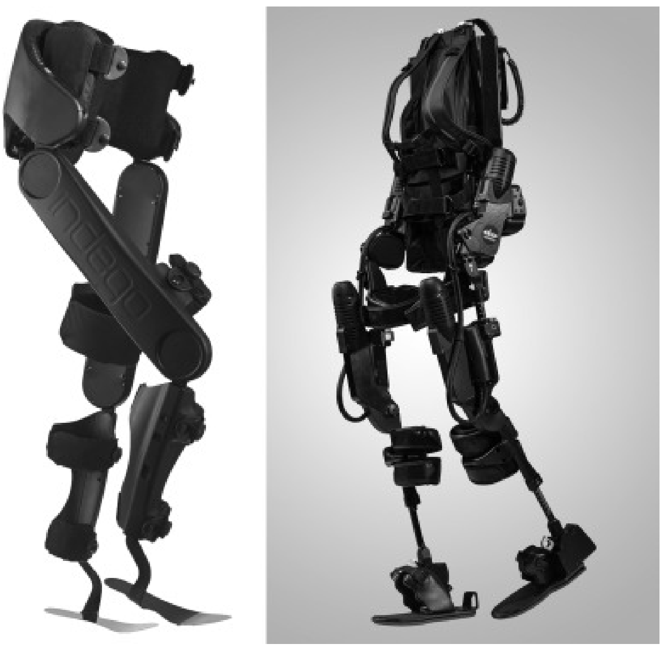


Figure1. A conceptual design of a robotic suit for SMA kids.

Mind-Controlled Robotic Exoskeleton and how it works:

Since the young girl has SMA, most of her muscles throughout the body do not function. So why not design something not only help her move hands and arm but also provide her the freedom to do all sorts of activities? Thus, this is why the robotic exoskeleton came out of my mind. It will be mind-controlled using the similar technology as my power arm design idea, however, it will control her whole body movement. Sort of like Iron Man but not able to fly.

Conclusions/action items:

This design is a well-built machine and is supposed to be highly accurate and stable. However, it requires complicated building techniques or calculations or advanced technologies. Also, the overall perspective cost is way beyond the budget.

Green Pass

James Tang - Feb 22, 2020, 10:26 PM CST

IMG_3774.jpg(1.1 MB) - download

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: