Inconspicuous Ankle Foot Orthosis (AFO) for teen

September 19th - September 25th, 2025

Client: Debbie Eggleston

Advisor: Dr. Justin Williams

Team Members:
Alex Conover (Team Leader)
Avery Lyons (Communicator)
Claire Matthai (BSAC)
Aditi Singhdeo (Co-BPAG)
Celia Oslakovic (Co-BPAG)
Sean Carey (BWIG)

Problem Statement:

Ankle-foot orthoses (AFOs) are designed to support dorsiflexion during the swing phase of walking. They are commonly used in managing muscular dystrophies, and for this project, our focus is specifically on adolescents with Facioscapulohumeral Dystrophy (FSHD), the most prevalent form of muscular dystrophy. Our goal is to create a brace that helps teens achieve safer walking by assisting ankle dorsiflexion, while remaining discreet, lightweight, and flexible enough to allow natural ankle motion. The main design priorities are to position the ankle in proper dorsiflexion, keep the brace slim and unobtrusive, and provide enough flexibility to reduce movement restrictions.

Status Update:

Design Matrix (viewable below)

Summary of Weekly Team Member Design Accomplishments (Include time spent):

Alex:

- Drafted up the preliminary design #2 (45 minutes)
- Wrote up some of the design matrix specifications, as well as rating the designs (1 hour)
- Contributed more research to the materials we could use (30 minutes)
- Added testing procedures for force plate testing (30 minutes)
- Met with team on Sunday 9/21 to discuss design matrix (45 minutes)

Avery:

- Researched competing AFO designs (90 mins)
- Wrote 2 categories for the Design Matrix and helped in ranking (30 mins)
- Met with team on Sunday (9/21) for Design Matrix discussion (45 mins)

Claire:

- Brainstormed and sketched a design idea (1.5 hr)
- Met with team on Sunday (9/21) to discuss Design Matrix (45 mins)
- Wrote one category for the Design Matrix (15 mins)
- Researched material choices for AFOs (1 hr)

Aditi:

- Researched factors that make an AFO more appealing for consistent use to help with the AFO design process (1.5 hours).
- Worked on the design matrix (30 minutes).

Celia:

- Sketched Design #1 for the design matrix and added labels for design dimensions (1.5 hours)
- Defined a category in the design matrix (30 min)
- Researched possible materials to use (30 mins)

Sean:

- Researched Fall 2024 bungee design (30 minutes)
- Research materials used in existing AFOs (30 minutes)
- Drew Design number 3 and worked on the design matrix (1.5 hours)

Weekly/Ongoing Difficulties

Upcoming Team and Individual Goals

Team:

- Continue work to finish the preliminary presentation
- Create a secondary design matrix (maybe) for types of materials

Individual:

Alex:

- Schedule a meeting with grainger lab to determine if they can help update the 3D files to support our new parameters.
- Also meet to consult what material would work best for the dorsiflexion aspect.
- Determine the best date to meet in person with the client.
- Delegate the preliminary presentation work and then finish the presentation for said presentation next Friday 10/3.

Avery:

- Email Progress Report #3 to the client and Professor Williams
- Receive preliminary feedback on the Design Matrix by Professor Williams
- Begin working on Preliminary Presentation slides

- Email client for update on Madison travel plans from the client on Sunday (9/28)
- Continue researching materials for the final design

Claire:

- Contribute to preliminary presentation content and prepare for the presentation
- Continue research on potential materials for the AFO

Aditi:

- Research what factors are generally evaluated when testing AFOs.
- Research materials that could be used.
- Work on the preliminary presentation.

Celia:

- Further research materials to use in fabricating our chosen design.
- Work on Preliminary Presentation for next week.

Sean:

- Research materials more
- Prepare for preliminary design presentation

Project Timeline

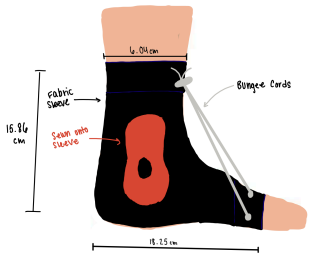
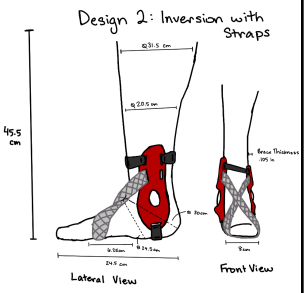
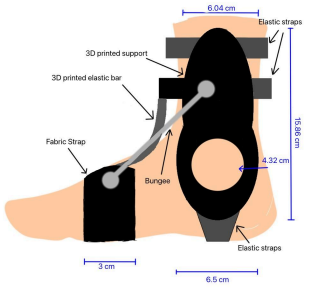
Project Goal	**Deadline**	**Team Member Assigned**	**Progress**	**Completed**
Meet with Client	9/10/2025		100%	
→ email client with dates	9/14/25	Avery	100%	
→ create question list		All	100%	
→ write summary and put in notebook		All	100%	
PDS Draft	9/18/2025		100%	
→ submit draft		Alex		
Design Ideas and Matrix	9/26/2023		10%	
→ create design 1		All		
→ create design 2		All		
→ create design 3		All		
→ compare designs in matrix		All		
Preliminary Design Presentation	10/03/2023		0%	
→ upload to website		Sean		
Preliminary Deliverables	10/08/2023		0%	

→ email report and notebook		Avery		
→ upload report to website		Sean		
→ peer/self evaluations		All		
Decide on Final Design	10/10/2023		0%	
→ get feedback from client on design		All		
Show and Tell	10/31/2023		0%	
→ create an initial prototype		All		
Final Poster Presentation	12/05/2023		0%	
→ invite client		Avery		
→ post on website		Sean		
Final Deliverables	12/10/2023		0%	
→ submit final notebook and report		Avery		
→ submit peer/self and client evaluations		All		

Expenses

Item	Description	Manufacturer	Part Number	Date	QTY	Cost Each	Total	Link
Component 1								
Component 2								
Component 3								
TOTAL:								**$0.00**

Design Criteria			

	 **Design 1: Combination Design 24-25**		 **Design 2: Inversion with Straps**		 **Design 3: In the Shoe**	
	Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score
Dorsiflexion Support (20)	3/5	12/20	4/5	16/20	5/5	20/20
Mediolateral support (20)	4/5	16/20	4/5	16/20	4/5	16/20
Ease of user assembly (15)	2/5	6/15	4.5/5	13.5/15	3/5	9/15
Comfort (15)	3.5/5	10.5/15	4/5	12/15	4/5	12/15
Durability (10)	4/5	8/10	4/5	8/10	3.5/5	7/10
Discreteness (10)	2/5	4/10	4/5	8/10	3.5/5	7/10
Fabrication Quality (5)	3/5	3/5	4/5	4/5	3/5	3/5
Cost (5)	3/5	3/5	3/5	3/5	2/5	2/5
Total	62.5/100		80.5/100		76/100	

Dorsiflexion Support (20%): Dorsiflexion support is one of the most important aspects of this design. The patient is experiencing foot drop, which is when the foot experiences a constant negative angle from the neutral position, meaning excess dorsiflexion, when the foot is set at a neutral position. The device needs to eliminate the excess dorsiflexion by assisting in plantar

flexion, the upward movement of the foot. This part of the support will help maintain proper gait and help reduce excessive heel strike.

Mediolateral Support (20%): Mediolateral support, crucial for any orthosis that aims to lessen the symptoms of FSHD, is the stabilizing force and support from the side-to-side axis of a body or joint. FSHD causes severe weakness in the muscles, leading to foot drop and problems with inversion of the ankle. This support helps maintain proper foot and ankle alignment during the stance and swing phases of gait.

Ease of User Assembly (15%): This criteria is important to consider when designing the AFO because our patient has FSHD, causing weakness in their right arm and a significant loss of function in the left. Therefore, the AFO needs to be easy to assemble to ensure they can use it independently without relying on others. If the device has intricate assembly steps, they will be less likely to use it consistently. By prioritizing ease of user assembly, the AFO is more practical for daily use making it more effective in the long run.

Comfort (15%): Comfort is an important criterion because the orthosis will be worn throughout the day for extended periods of time. The AFO must minimize pressure points, prevent skin irritation, and distribute forces evenly across the foot and ankle. If the device causes pain, rubbing, or excessive heat buildup, the user will be less likely to wear it consistently, therefore reducing its effectiveness. A higher score represents a design that avoids irritation and feels natural to the user.

Durability (10%): Durability is an important aspect of the AFO because it needs to withstand repeated daily use and exposure to different environments. The AFO needs to support the users gait without wearing down too quickly or losing effectiveness over time. A durable AFO reduces the risk of breakage or frequent repairs, which is especially important because breakage during use can put the user at risk of falling and injuring themselves.

Discreteness (10%): The discreteness of the AFO has proven to be an important aspect of the design over the last semester's work due to the age of the patient. The AFO needs to draw no more attention than a regular ankle brace for an ordinary injury would. The patient has demonstrated that they will not wear the brace if it is bulky, highlighting their FSHD. One of the goals of this design is to make it discrete enough that it can be covered with loose pants.

Fabrication Quality (5%): The fabrication quality of the AFO is key to its functionality. If it breaks like in previous years, it is crucial to ensure that there would be no sharp edges that could cause harm to the patient. Additionally, rough edges would need to be sanded and deburred to avoid discomfort during everyday wear. The AFO would also need to withstand many years of

wear so that the patient does not need a new one to be fabricated immediately when the project is finished.

Cost (5%): The cost of the AFO is an important factor to consider in the choice of design. The materials chosen should not only perform their own functionality adequately, but also be within the scope of our budget of $100. This budget should account for not only upfront costs of fabrication of the AFO, but also any maintenance costs that may be needed for the design to continue to perform sufficiently.