Safe Shower Solution for Below-the-Knee Amputee
Progress Report 9

November 2, 2026 – November 9, 2026

Client: Mike DeGrave

Advisor: Prof. Murphy

Team:n
Sam Dudek - dudek4@wisc.edu (Co-Team Leader)
Ben Willihnganz - bwillihnganz@wisc.edu (Co-Team Leader)
Claire Matthai - cematthai@wisc.edu (Communicator)
Katelyn Williams - kmwilliams37@wisc.edu (BWIG)
Kimberly Jarrard - kjarrard@wisc.edu (BPAG)
Marcus Wentzel - mfwentzel@wisc.edu (BSAC)

Problem Statement

Below-the-knee amputees are unable to wear their prosthetic in the shower, as most prosthetic legs are not waterproof and are prone to corrosion and slippage. This forces individuals to either remove their prosthetic and shower while seated, or attempt to stand on one leg using unsafe workarounds - both of which carry significant fall risk. The objective of this project is to design a device that gives below-the-knee amputees the autonomy to safely enter, stand, and bathe in the shower without their prosthetic, restoring independence and reducing injury risk during a daily activity. This project is being developed in partnership with Mike DeGrave, a below-the-knee amputee whose personal experience with this challenge is the driving inspiration behind the work.

Brief Status Update

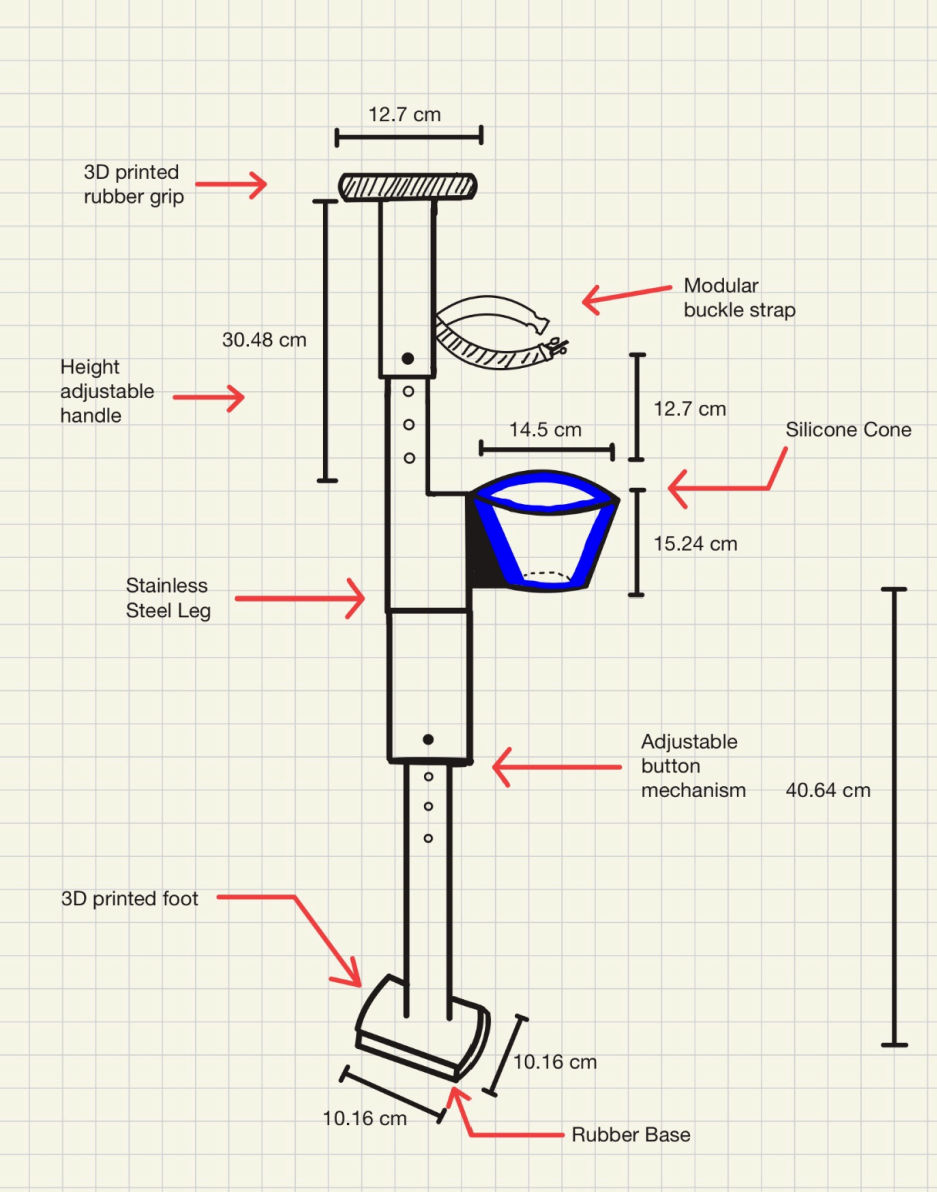
This week the team split into 2 groups each with a different focus for the prototyping and testing portion of this project. The two groups will focus on both the cone and the base of the “Air Jordan” design. The cone team will be focusing on modeling and 3D printing the initial cone design as well and creating a 3D printing material design matrix. The foot/base team has been focusing on the means of fabricating within the shop and the adhesion protocol between EVA Foam to our UHMWPE.

Difficulties / Advice Requests

N/A

Current Design

Modified Air Jordan:



Materials and Expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Preliminary										
Drive Air-Crutches with	Anodized Aluminum Crutches	Drive DeVilbiss Healthcare	MD10300BK	DME Superstore	MD10300BK	10/19/2026	1	$109.99	$109.99	Crutches

Airgonomic Underarm Cushions - Onyx										
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$109.99**	

Goals

Major team goals for the next week

1. Finalize fabrication of the cone and the base.
2. Begin testing of the comfort for the cone and schedule a client meeting.
3. Begin testing the coefficient of friction of the base to ensure safety measures are met.

Next week's individual goals

- Sam Dudek
    - Research different properties of EVA foam for our anti-slip material on the bottom of our foot
    - Research adhesion properties of common plastics and foams to try and find a way to connect our materials together
    - Met with the cone team to talk about how to fabricate our foot via machining
- Ben Willihnganz
    - Research fabrication methods for silicon and EVA foam to line the inside of the cone
    - Implement comfort measure to the inside of the cone to ensure
- Claire Matthai
    - Work with the cone team
- Katelyn Williams
    - Decide materials that will be used for lining the cone and create fabrication steps aligned with those materials
    - 3D print the cone prototype with selected material
- Kimberly Jarrard
    - Finalize materials that we will be using for the foot and order them
    - Start fabrication for the foot of the design
- Marcus Wentzel
    - Finalize the materials for the foot
    - Order the materials for the foot so that we can begin machining

Timeline

Task	September				October					November				Dec	
	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11
Project R&D															
Brainstorm	X	X	X	X											
Research		X	X	X	X	X	X	X	X	X					
Prototyping & Fabrication								X	X	X					
Testing & Validation															
Deliverables															
Progress Reports		X	X	X	X	X	X	X	X	X					
PDS			X												
Design/Decision Matrix Criteria				X											
Prelim Presentation					X										
Show and Tell									X						
Final Poster															
Meetings															
Client			X	X	X										
Advisor	X	X	X			X	X	X	X						
Website															
Update	X	X	X	X	X	X	X	X	X	X					

Filled boxes = projected timeline
X = task was worked on or completed

Detailed Accomplishments

The team split up into two groups and separately have been doing extensive research and designing of our two main individual pieces: the foot and the cone. Our groups are as follows:

Cone: Katelyn, Ben, Claire

Foot: Marcus, Kimberly, Sam

Previous Week's Goals and Accomplishments

- Sam Dudek
    - Fabricate and start thinking about the foot fabrication plan
    - Research material options for 3D printing of the cone, material for the inside of the cone, and material for the foot
- Ben Willihnganz
    - Fabricate and initialize the beginning of the prototyping phase

    - Research more material options for 3D prints and other materials that can be machined
- Claire Matthai
    - Help source materials for the foot and create a fabrication plan
    - Communicate with Mike and family to find a time to meet before Thanksgiving
    - Finalize a material for the cone based on our research and input from show and tell
- Katelyn Williams
    - Utilize FEA on a CAD model to determine if component can withstand proper weight
    - Consider feedback from show and tell to drive new research or future steps on the design
    - Begin fabricating any components that are ready for the prototype
- Kimberly Jarrard
    - Look over the 3D printed small prototypes and make adjustments as needed
    - Continue to work on the crutch and start fabricating parts to test attached to the crutch
    - Take suggestions from the Show and Tell to improve our design
- Marcus Wentzel
    - Determine the exact dimensions of the prosthetics based on the measurements taken of the client's leg
    - 3D print scaled down designs of the prosthetic components and the client's residual limb to observe how they interact with each other.
    - Implement any feedback from show and tell into our project

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Sam Dudek		Research the general properties of EVA Foam, Polymers, as well as their adhesion properties and different methods of adhesion	2	4	34
		Create a fabrication plan for the adhesion of EVA foam to our polymer of choice	1		
		Meet with the foot team to discuss the fabrication methods for the foot.	1		
Ben Willihnganz	11/5	Meet with the cone team to discuss deadlines and other goals for our team	1	5	33
	11/4	Research the 3 3D materials in the design matrix to ensure every design is considered	2		

	11/4	Look into the print quality of carbon fiber based prints and understand the price	2		
Claire Matthai	11/3	Created a design matrix for potential cone materials and summarized the main pros and cons of each material to share with the cone team.	2	5	34.5
	11/3	Looked into closed-cell EVA foam options on the SoleTech website and researched attachment methods.	1		
	11/4	Created a list of tests to consider to test effectiveness of the cone piece under loads and in wet, soapy conditions.	1		
	11/5	Met with the cone team to share these ideas and continue progress on our part.	1		
Katelyn Williams	11/4	Developed a CAD model of the cone and crutch connection. Ran FEA studies on the part.	2.5	4.5	29
	11/5	Researched different types of biocompatible coatings that would waterproof a PETG-CF printed cone.	1		
	11/5	Met with the cone team to discuss material selection and goals.	1		
Kimberly Jarrard	10/31	Researched and learned more about PETG and compared all plastic materials that the team has discussed so far.	1.5	3	26.5
	11/4	Brainstorm materials for the foot to bring up during our meeting	0.5		
	11/5	Meet with the foot team and discuss our next plans	1		
Marcus Wentzel	11/2	Research materials for the foot of the	2.5	3.5	27.75

	11/5	prosthetic Meet with the foot team to discuss what we researched and our next course of action	1		