THE PROSTHETIC KNEE PROJECT

School of Science, Engineering and Health Symposium (Spring 2019)

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Introduction & Problem Statement

Partners

1) **Centre for the Advancement of the Handicapped in Mahadaga, Burkina Faso**
2) **CURE Kenya Orthopedic Hospital in Kijabe, Kenya**

- There are many trans-femoral amputees in both of these partner locations mainly due to infection
- Amputees without a prosthetic cannot provide for themselves
- Terminated supply of donated prosthetic knees (Burkina), and high cost of commercial prosthetic knees (Kenya) created a need for low-cost, locally manufacturable prosthetic knees
- Challenges:
  - Lack of materials and limited manufacturing capabilities
  - Need to tailor prosthetics to cultural factors
  - Communication with Burkina

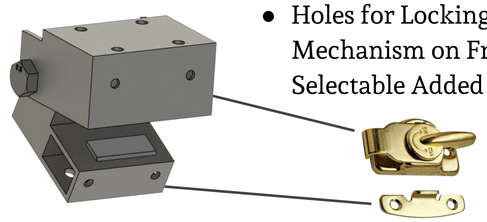
Group Mission

This project aims to aid individuals with physical disabilities by providing a solution to their limitations through the production of a fully functional, low cost ($20) prosthetic knee that will be integrated to a readily available transfemoral prosthetic leg available in Mahadaga, Burkina Faso and Kijabe, Kenya.

Photographed from Left to Right: Miranda Chiang, Nyles Rife, Bryson Boettger, Matt Tavani, Vaughn Chambers & Dr. Jamie Williams

Current Design

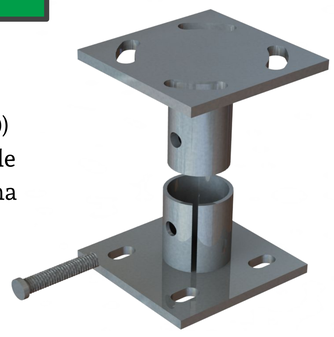
- Holes for Pyramidal Attachments on Top and Bottom
- Posterior-Shifted Axis for Added Stability
- Made of Steel using only Cutting, Drilling and Welding



- Holes for Locking Mechanism on Front for Selectable Added Stability
- Magnet for Additional Extension Assist
- Costs Less than $20 to Manufacture

Alternative Prosthetic Adapter

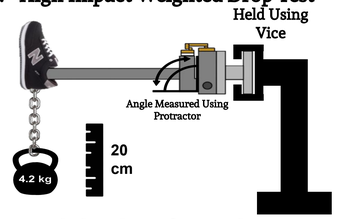
- The Standard Pyramid Adapters (right) are universally used to connect prosthetic limbs together. They connect to both the top and bottom of our knee design. These cost about $50/adapter used on Ebay.



- This is not practical for a prosthetic knee that costs less than $20. Our project has taken on the task of designing adapters (left) that could be made locally in both of our partner locations.
- The incorporation of curved slots allows for approximately 20° of rotational ability, which helps the amputee find the optimal alignment for their prosthetic leg.

Strength & Fatigue Testing

1. **High Impact Weighted Drop Test**



- Lock broke after 5 drops.
- Test was not realistic due to the rigidity of the vice used.

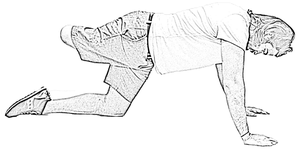
2. **High Impact Kick Test**

- Kicked the wall 1500 times.
- Meant to simulate a "toe-stubbing."
- Little measurable deformation after 1500 kicks.

Rehabilitation Protocol

- Exercise program designed to keep amputees strong and flexible until they receive their prosthetic limb.
- This program is a 3-phase process that patients work their way through with increasing difficulty.
- Throughout the process, both strength training and stretching exercises will help to prepare the patient to better receive their prosthetic limb.

Example Stretches



Acknowledgments

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- Dr. Jamie Williams- Project Manager and Consultant
- Dr. Emily Farrar- Project Founder and Consultant
- Eric Shoemaker (MS, CPO)- Professional Consultant
- John Meyer- Manufacturing Assistance
- Dr. Timothy Van Dyke- Finite Element Analysis Assistance

And an extra special thanks to Andrew for generously volunteering to test with us

Conclusion

- We currently have a viable design that has been tested and proven to work safely and effectively. With limited communication with Burkina, we are delivering them a finished product that satisfies their design requirements.
- Matt, Miranda, and Bryson will be traveling in May 2019 to determine the design requirements for CURE Kenya.

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