PROSTHETIC KNEE FOR BURKINA FASO

School of Science, Engineering and Health Symposium

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Introduction & Problem Statement

- There are many amputees in Burkina Faso because of disease, malnutrition, natural disasters, and war
- Amputees cannot provide for themselves
- Terminated supply of donated prosthetic knees created a need for a locally manufacturable prosthetic knee
- Challenges
  - Lack of materials
  - Not enough highly-trained prosthetists
  - Need to tailor prosthetics to cultural factors
- As a result from our recent site team trip to Burkina Faso, we learned that our client wants a locking mechanism to be able to switch between a static (non-bending) and dynamic (bending) knee.

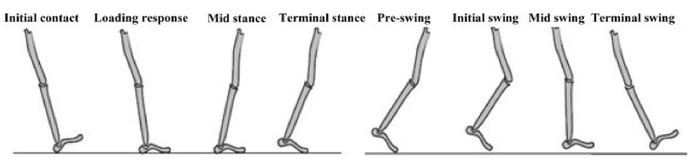
Group Mission

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 eventually be integrated to a readily available transfemoral prosthetic leg available in Mahadaga, Burkina Faso.

Gait Analysis

Static Knee (Non-Bending)
- Advantages
  - Easy to use/minimal training
  - More stable
- Disadvantages
  - Altered gait
  - Risk of chronic injuries

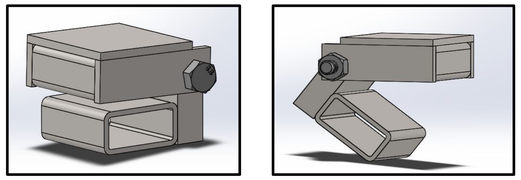
Dynamic Knee (Bending)
- Advantages
  - Normal gait pattern
  - Less lifestyle changes
- Disadvantages
  - Training needed
  - Difficulty on unstable ground



Approach

- Prototyping: 3D printed Solidworks model and manufactured steel prototype.
- Assessment of Performance: Gait Testing and Finite Element Analysis (FEA) in Solidworks.
- Feedback: Communication with partners and clients in Burkina as well as discussions with Dr. Shoemaker.

Current Design



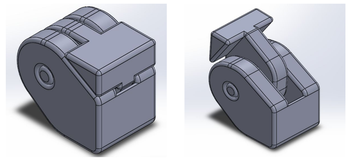
- Our current design is made completely out of steel, since that is the most readily available material in Mahadaga, Burkina Faso.
- The pyramidal attachments on the top and bottom components are universal attachments commonly used in prosthetics. These attachments will connect to the socket and shank (lower leg) that are currently made in Mahadaga.
- This knee includes a locking mechanism to allow the patients to lock the knee in order to achieve more stability on uneven terrain. The lock allows them to easily switch between a static and dynamic knee.

Conclusion

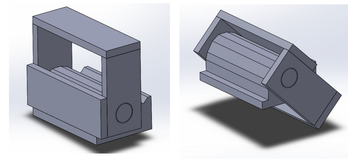
Currently, we are fine tuning our first prototype design. We are going to make modifications to our current design based off the feedback that Vaughn gets from his trip to Mahadaga in May. Looking forward, our future goals are:
- Further our relationship with the Handicapped Center
- Implement knee design in Mahadaga
- Work with staff at the Handicapped Center to encourage use of prosthetics with positive effects on health
- Work with technicians to install knee properly

Past Designs

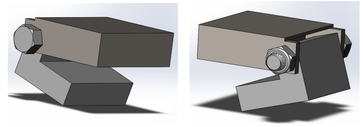
First Generation Knee Design



Second Generation Knee Design



Third Generation Knee Design

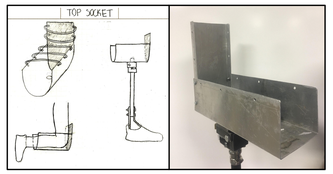


These are the images of how our knee design has progressed throughout the life of this project. With manufacturing and testing in mind, we redesigned the knee to reduce complexity and focused on functionality.

Testing

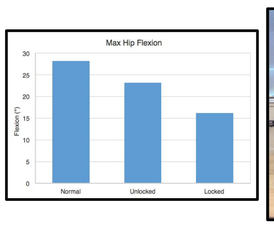
Methodology:
- Subject placed knee in socket
- Pipe clamps and ace bandages used to secure the socket to the knee
- Used tables for support instead of parallel bars

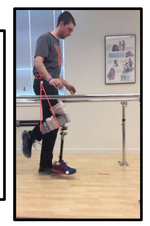
Testing Apparatus



On the left is the drawing of the socket and on the right is the modified version we constructed for testing purposes.

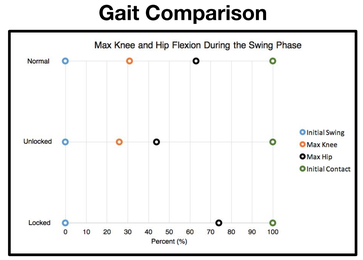
2-D Analysis





This is an example of the 2D video analysis that we performed. It shows the max hip flexion of a healthy individual compared to the locked and unlocked configurations of our knee.

Gait Comparison



This graph shows the max knee and hip flexion during the swing phase comparing normal, locked and unlocked configurations.

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