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Prosthetic Knee

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PROSTHETIC KNEE



2020 Collaboratory/Engineering Symposium

Sarah Kelchner, Sam Burgess,
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Introduction & Problem Statement

Partner:

CURE Kenya Orthopedic Hospital in Kijabe, Kenya



- There are many lower-extremity amputees in the region due to infection and diseases
- Through-knee prosthetics are very expensive (\$2,500 USD)
- Through-knee amputees often undergo a more invasive and debilitating trans-femoral surgery out of financial necessity
- There is a great need for affordable through-knee prosthetics

Group Mission

This project aims to aid individuals with physical disabilities by providing a solution to their limitations through knee-disarticulation prosthetics that are fully functional, low cost, aesthetically pleasing and eventually locally manufacturable.



Photographed from Left to Right: Sam Burgess, Dr. Jamie Williams, Sarah Kelchner, Ike Bryner, Josiah Moyer, Clint Meekins, Bryson Boettger, Kay Laura Sindabizera, and Matt Tavani

Knee-Disarticulation Amputation

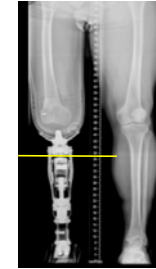
A knee disarticulation is a lower extremity amputation in which the leg is severed directly through the knee joint, preserving all or nearly all of the femur.

Advantages:

- Preserves anatomical infrastructure of knee
- Reduces force on limb and socket during walking
- Increased patient comfort and stability

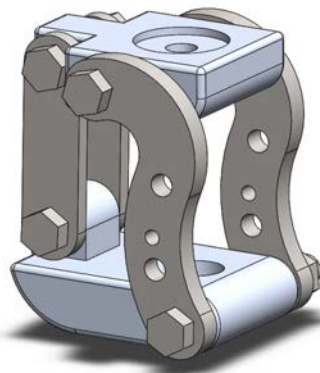
Challenges :

- Thigh-lengthening (gap between the anatomical and prosthetic knee's axes of rotation that complicates walking and sitting)



Design Process and Current Working Design

Our current knee design, after multiple iterations of the design and testing process, is shown below.

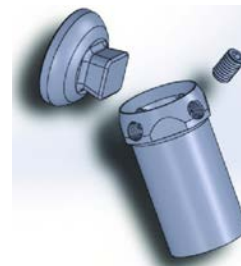


Above: Knee in extension with openings to allow for easy access to adaptor connection points

Right: Pyramid adapter with bolt connection to knee (top and bottom)



Left: Pyramid adapter for bottom connection to shank adapter

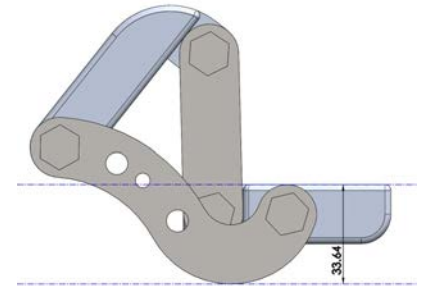


Design Criteria

The Prosthetic must be :

- Proportioned to minimize thigh lengthening
- Lightweight
- Aesthetically appealing
- Simple to manufacture to reduce costs

Our current design meets these criteria and has little thigh lengthening.



Above: Knee in flexion with maximum thigh lengthening shown (33.64 mm), not including adaptor

Conclusion

We currently have a design prototype to begin stress analysis, which will provide valuable feedback for changes that need to be implemented to optimize the design.

We aim to deliver a finalized design with a manufacturing protocol by May 2021.

Acknowledgements

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- Tim Howell-Project Consultant
- Andy Erikson-3D Printing Assistance

