Integrating Engineering Design with Adaptive Sports: Developing Kayaking Equipment for Spinal Cord Injury Athletes

Elizabeth Blade[1] (medical student), Aaron Burdette[2], Dr. Victoria Heasley[3] (PI)

[1] University of Cincinnati College of Medicine, [2] Biomedical Engineering, [3] Neurology and Rehabilitation Medicine

This project explores the integration of engineering and design into the development of adaptive sports equipment for individuals with physical disabilities, focusing on kayaking for individuals with spinal cord injuries (SCI). Over a 10-week period, I collaborated with The Bridge Adaptive Sports and Recreation's kayak program to design and prototype a pelvic and leg stabilization device that addresses the unique needs of SCI athletes.

Kayaking demands significant trunk stability, which poses substantial barriers for individuals with SCI, limiting their participation in this therapeutic and recreational activity. My involvement began by volunteering with The Bridge, where I engaged with SCI athletes to understand their specific challenges with existing adaptive equipment. Through this contextual inquiry, I identified the need for improved pelvic stabilization to enhance trunk stability and a leg safety cushion to ensure comfort and safety during potential kayak capsizes.

Drawing on principles of ergonomics and material design, the research team developed an adjustable, inflatable two-chamber support system with varying firmness levels to stabilize the pelvis and legs. This prototype was field-tested during the Cincinnati Paddle Fest on the Ohio River with an SCI athlete. Based on feedback, refinement of the design to better meet user needs will continue.

This experience has deepened my understanding of the critical role biomedical engineering plays in creating user-centered medical innovations that enhance the accessibility of adaptive sports. It underscores the value of incorporating engineering design into medical education, enabling future physicians to collaborate more effectively with engineers in developing tailored medical devices that improve patient outcomes.

Contact Information: Elizabeth Blade

Email: bladeeg@mail.uc.edu

Phone: (615)708-1494

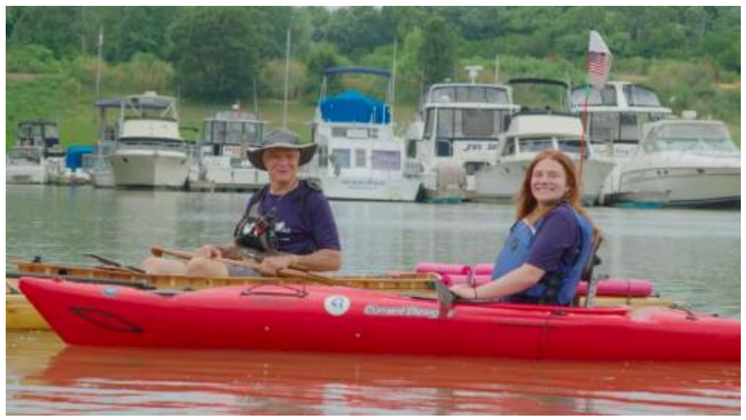
Key Words: Engineering design, adaptive sports, physical disabilities, spinal cord injury, accessibility, kayaking

Integrating Engineering Design with Adaptive Sports: Developing Kayaking Equipment for Athletes with Spinal Cord Injuries

Elizabeth Blade[1] (medical student), Aaron Burdette[2], Dr. Victoria Heasley[3]
[1] University of Cincinnati College of Medicine, [2] Biomedical Engineering, [3] Neurology and Rehabilitation

Introduction

- Over a 10-week period this summer, I worked with the biomedical engineering department at University of Cincinnati and The Bridge Adaptive Sports and Recreation to create adaptive kayaking equipment for athletes with spinal cord injury (SCI)
- Kayaking demands significant trunk stability posing barriers to athletes with SCI participation



Methods

- I engaged with athletes with SCI through the Bridge to understand their specific challenges with existing adaptive equipment
- Through this contextual inquiry with the athletes, I identified two main challenges:

1) Their legs could get caught in the lip of a kayak should the kayak capsize
2) The lack of hip support in the seats made them feel unsteady and struggle with balance

- I researched materials, created multiple designs, and ranked different factors corresponding to each design idea to build the best prototype

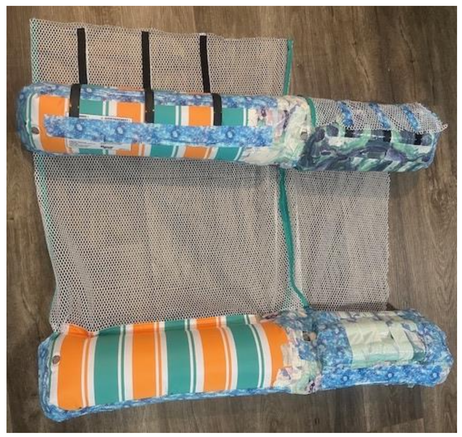
Purpose

- To create a hip and leg support for a recreational kayak that is safe and comfortable regardless of kayaker size
- The product had to be lightweight, waterproof, and adjustable

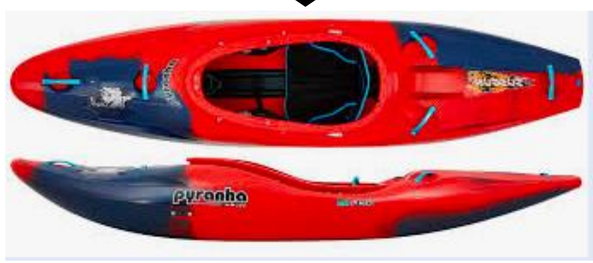
Prototype Design

- Materials included two pool floats, a pool noodle, duct tape, and velcro
- Two inflatable compartments on each side of the body, one focusing on the hips and the other on the legs allowing for different levels of inflation
- The hip compartment has extra sturdy foam for more support
- In between the inflatables is a waterproof mesh with velcro to adjust the distance between the inflatables
- Smooth texture avoids skin irritation
- Overall, this design helps keep the athletes' legs from getting stuck in the kayak and adds extra stability to their hips

Materials



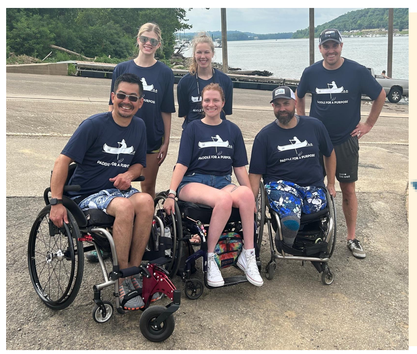
Prototype

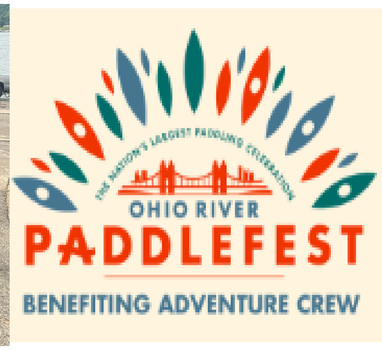


Prototype is placed in the kayak before the athlete and then is deflated and adjusted to their comfort

Discussion

- I tested the prototype at Paddle Fest, where the adaptive athletes completed the route of 4.5 miles along the Ohio River
- The athlete appreciated the inflatable prototype, and it expedited her process of preparing
- Her kayak was comfortable and sturdy throughout the 2-hour river trip
- However, the velcro was not sturdy on the mesh after soaking in the water, so future iterations of the prototype would enhance the velcro to prevent water damage
- Overall, this experience has deepened my understanding of the critical role biomedical engineering plays in creating user-centered medical innovations that enhance the accessibility of adaptive sports





Acknowledgements

- I would like to thank Danny Meyer, Aaron Burdette, Dr. Victoria Heasley, and the Urban Health Project for guiding me through my internship experience at the Bridge
- I would also like to extend my gratitude to all the athletes, staff, and volunteers at the Bridge for all their support and for making me feel so welcomed into this community