Chris Fahey- Adaptive Hand Orthotic

Overview
Chris Fahey, PSU Ortho’s sponsor, lost part of his arm in a motorcycle accident. His right arm was amputated from the elbow down. After a successful surgery, the arm was reattached but due to nerve damage, the range of motion in his hand is limited to only 20%. Team PSU Ortho needs to use their engineering background to design an attachable device that will restore function to Chris Fahey’s arm.

Objectives
The designed orthotic aids Mr. Fahey in performing basic daily activities such as hammering a nail, handling a telescope, and holding a glass. Functionality, durability and weight are all major factors influencing the direction of this project.

Approach
- Customer needs were determined using a pairwise comparison chart, resulting eight different selection criteria.
- After analyzing the eight criteria the team generated 5 concepts which were evaluated through a concept screening matrix and a concept scoring matrix.
- PSU Ortho visited Health South Rehab Center to analyse existing orthotics.
- The team met with their sponsor to gather feedback throughout the design process and collect necessary measurements for the hand casting.
- Finite element analysis was performed to test the maximum stresses on the aluminium rod and a free body diagram to evaluate the frictional force to keep the rod static.
- SolidWorks software was used to create a 3D model of the hand orthotic.
- A prototype was created using the workshop in Health South Rehab Center and Penn State’s Learning Factory to be further tested for functionality.
- Several tests were performed with Chris Fahey to ensure that his needs were satisfied. For example screwing a nut and lifting a steel block.
- The test results showed that the orthotic hand would function best during moderately heavy applications.

Outcomes
- The v-shaped rod support accommodates a variety of cylindrical diameters which allows multi-functionality.
- Aluminum and thermo-plastic will be the main materials used in the design. Weight= $1.8$ lbs. With maximum durability.
- The threaded rod will allow a variation of grips to be attached depending on the user’s preference.
- The manufacturing cost is affordable ($108.93 excluding model 5X hook terminal device)
- Customized thermo-plastic base ensures complete contact and comfort on the patient’s hand.