Bio Exo Skulder – The Shoulder Brace

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Introduction

The shoulder joint is:

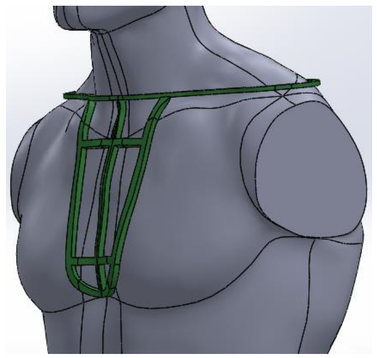
- A ball-and-socket joint (3 degree of freedom)
- Stabilized by the rotator cuff, a group of muscles and tendons
- Highly susceptible to injury
- Difficult to repair due to its complexity

Problem

- Current shoulder braces compress the joint and limit its movements, providing very little support to the joint

Solution

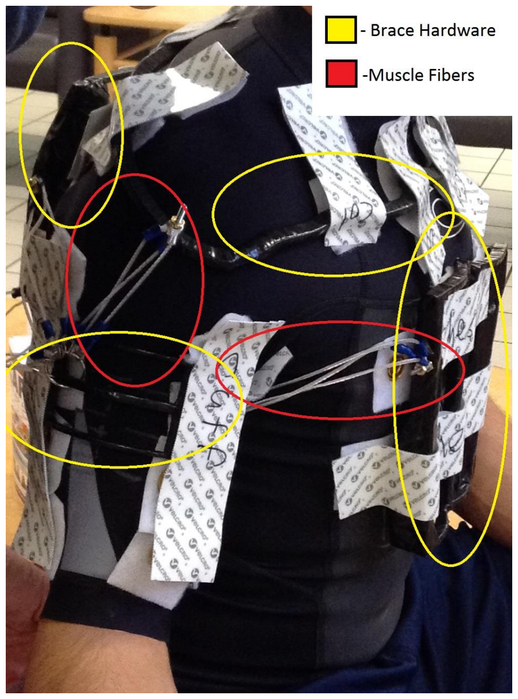
- Create a novel shoulder brace that:
  - supports the joint
  - allows normal shoulder movements
  - reduces the pain
- Using biomimicry we copy the body's physiology to create an engineering solution



Modified Design

Design

- Brace requirements:
  - light weight
  - Comfortable
- Brace properties:
  - plastic frame for chest and arm sitting on a on neoprene under layer
  - Chest and arm connected by elastic bands, which mimic the physiology of the shoulder muscles

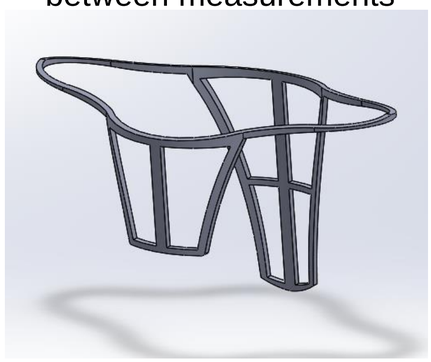


First Prototype

Methods and Testing

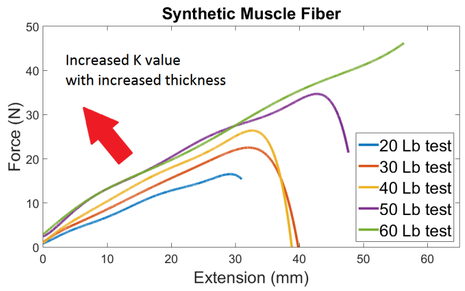
We collected data on:

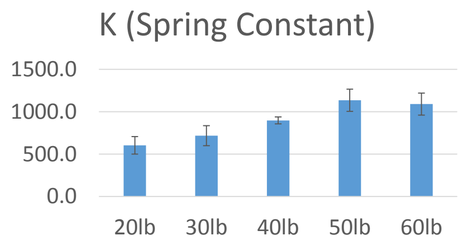
- the mechanical properties of elastic fibers (50 mm length) with different weights
  - spring constant, maximum stretch length, and failure points
- the performance of healthy and injured rotator cuff athletes (N = 6/group) when wearing, or not, the brace. We measured:
  - range of motion (ROM) of the shoulder joint without the brace (baseline, compared to values in literature)
  - one week later, ROM of the shoulder joint with the brace
  - pain levels at subject specific extreme ROM
  - the subjects didn't get any rehabilitation between measurements

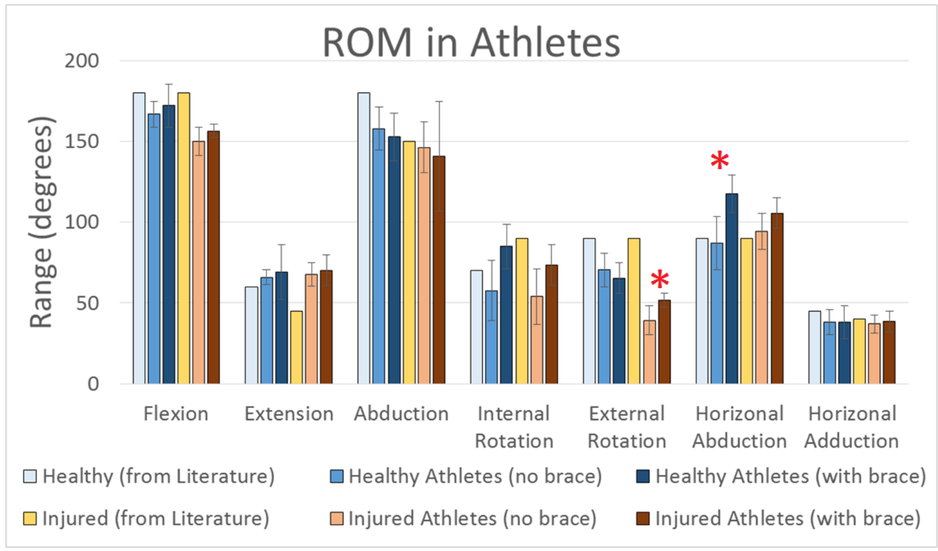


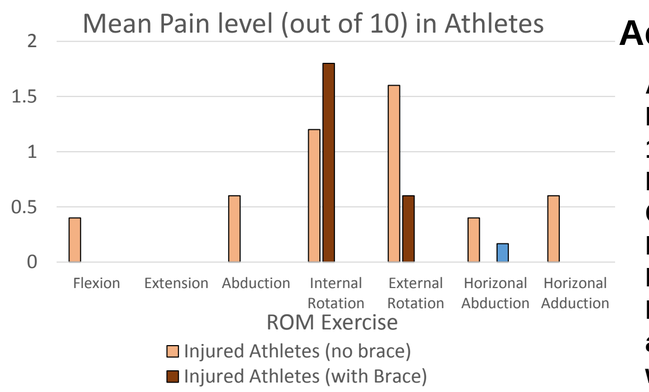
Original Design

Results









Conclusions

The muscle fibers:

- had increasing spring constant with weight
- were ideal to functionally simulate muscle
- provided relief for soft tissue in the shoulder

The brace:

- Increased ROM
- Reduced the pain levels in injured athletes except for internal rotation

Acknowledgements

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NORTHROP GRUMMAN

Engineering & Science Student Design Showcase at Florida Institute of Technology