# Tri-Axial Hinge Knee Brace

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# Overview

- Problem Statement
- Background
- Current Device
- Design Specifications
- Design Alternatives
- Design Matrix
- Final Design
- Future Work

# Client Description

- Dr. Sarah Kuehl
  - Project Engineer at Mueller Sports Medicine


**Figure 1:** Mueller Sports Medicine logo.

# Problem Statement

- Tri-Axial Hinge Knee Brace
  - Mimics proper knee flexion
  - Provides desirable amount of knee stabilization
- Current Issues
  - Straight profile does not match patient profile well - causing some discomfort
- Goal
  - Redesign the straight profile to better contour to as many patients with the fewest models

# Background

## Current Knee Brace

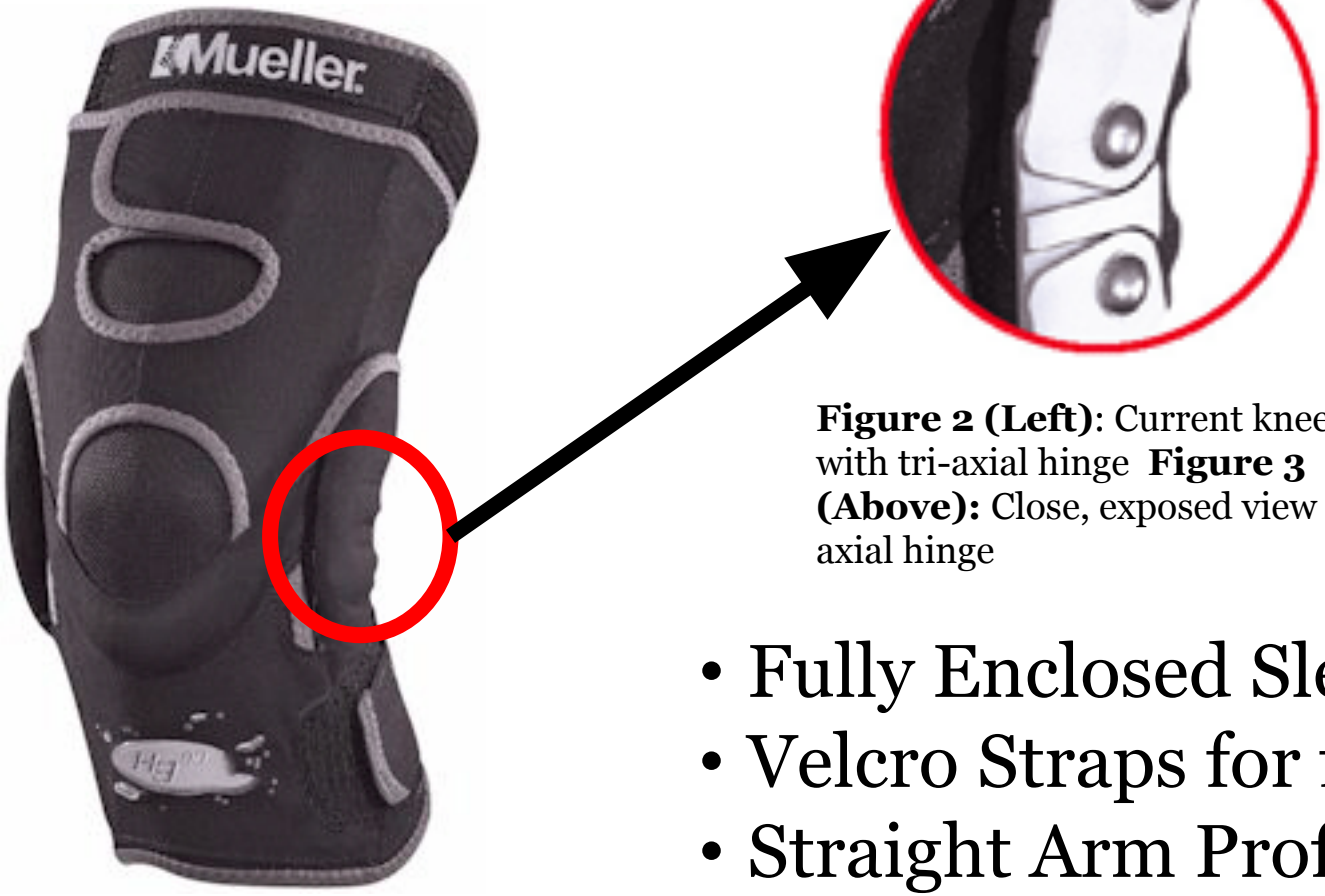


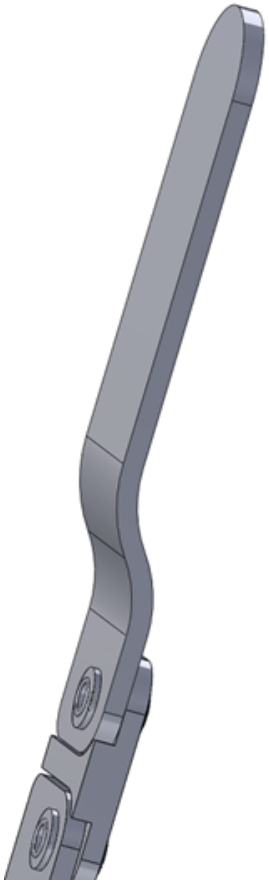

**Figure 2 (Left)**: Current knee brace with tri-axial hinge **Figure 3 (Above):** Close, exposed view of tri-axial hinge

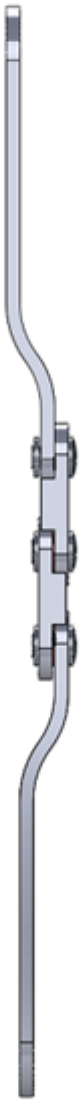
- Fully Enclosed Sleeve
- Velcro Straps for fit
- Straight Arm Profile

# Tri-Axial Hinge Motion

**Figures 4-7:** The Tri-Axial Hinge is capable of 180° of motion.

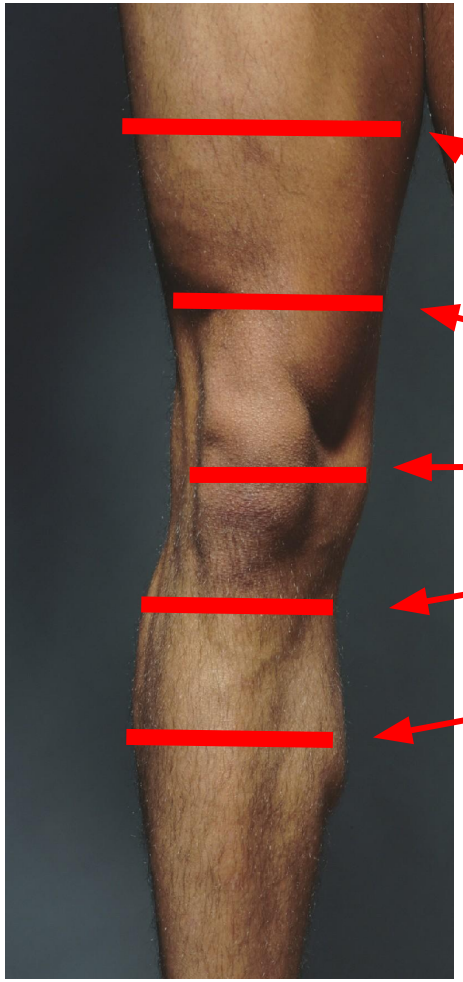
# Current Design





**Figures 8 & 9:** The current design that Mueller Sports Medicine uses in their knee braces.

# Average Leg Dimensions



- Upper Leg Length = 47.73 cm
- Mid-Thigh Circumference = 51.62 cm
- ¼ Thigh Circumference = 41.68 cm
- Knee Circumference = 37.49 cm
- ¼ Calf Circumference = 35.91 cm
- Mid-Calf Circumference = 36.40 cm
- Lower Leg Length = 45.32 cm

**Figure 10:** Image showing where leg measurements were taken.

# Design Specifications

- Lightweight: Aluminum
- Durable: >1 year
- Restrict Motion
  - Lateral Direction
  - Hyperextension
- Allow for proper range and motion of flexion
  - Tri-Axial Hinge
  - 180°
- Conform to as many patient's legs as possible
  - One-size fits all
- Comfort
- Low cost: < $100

# Design Alternatives

# Design 1: Y-shape

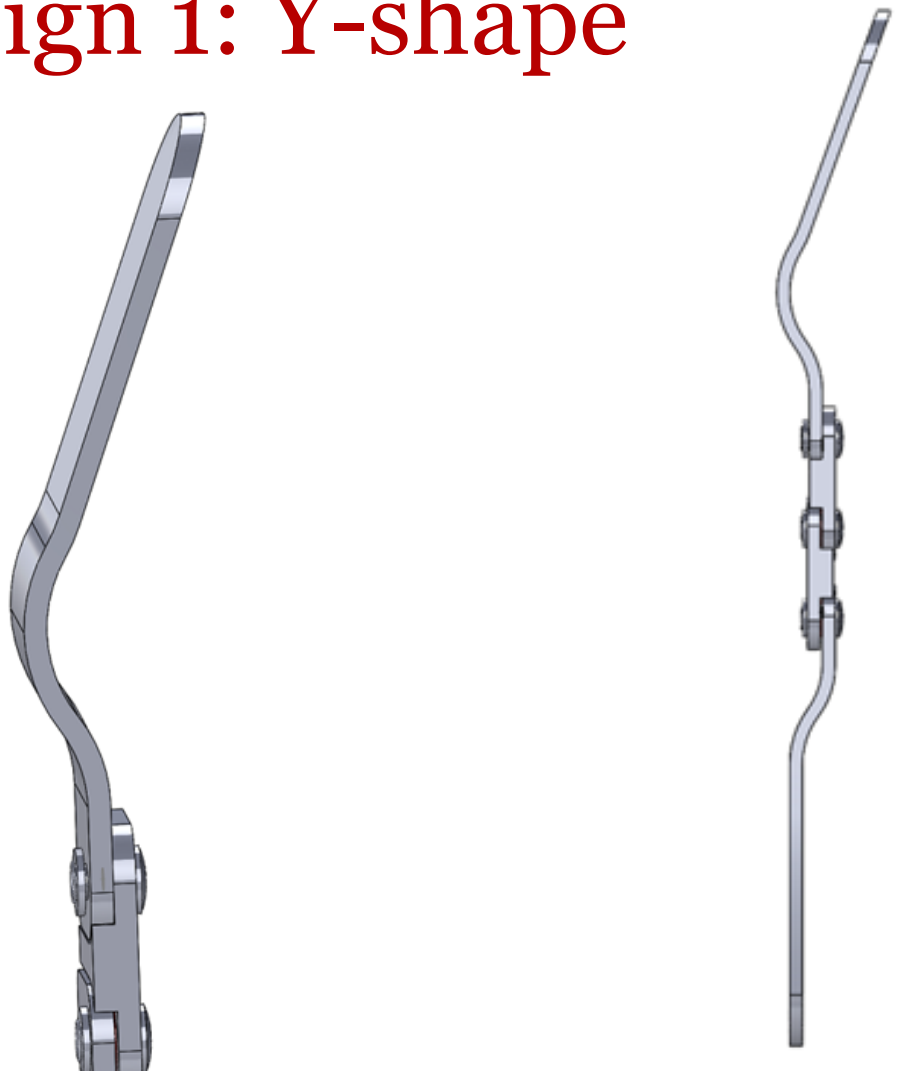


**Figure 11& 12 :** Solidworks model of the Y-Shape design.

# Design 2: Curved

**Figure 13 & 14:** Solidworks model of Curved design.

# Design 3: Adjustable

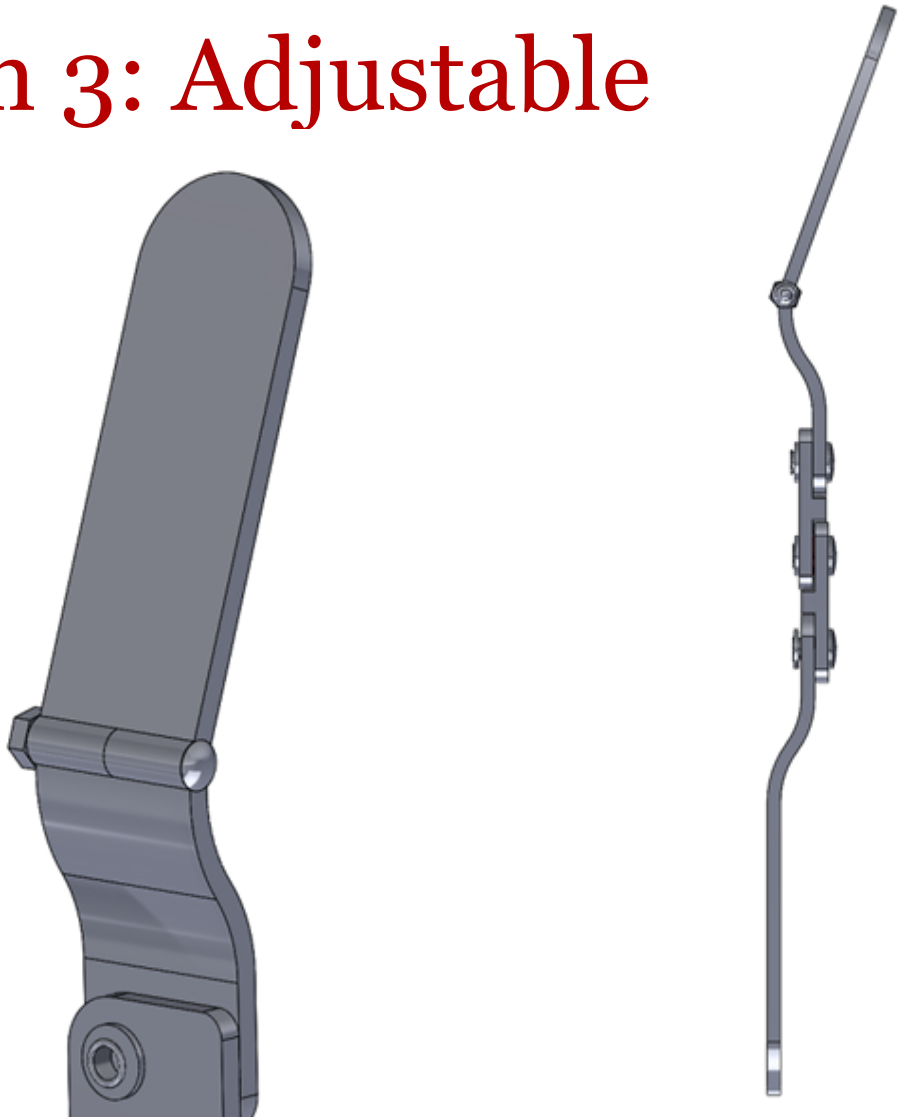


**Figure 15 & 16:** Solidworks model of the Adjustable design

# Design Matrix

| | Y Design | | Curved Design | | Adjustable Hinge Design | |
|---|---|---|---|---|---|---|
| Fit to Body (30) | 12 | 2 | 12 | 2 | 30 | 5 |
| Strength (20) | 16 | 4 | 16 | 4 | 12 | 3 |
| Obstruction (15) | 9 | 3 | 6 | 2 | 15 | 5 |
| Manufacturability (15) | 15 | 5 | 6 | 2 | 6 | 2 |
| Durability (10) | 20 | 5 | 16 | 4 | 12 | 3 |
| Cost (10) | 4 | 4 | 2 | 2 | 2 | 2 |
| Total (100) | 76 | | 58 | | 77 | |

**Table 1:** Design Matrix

# Final Design

## Overview

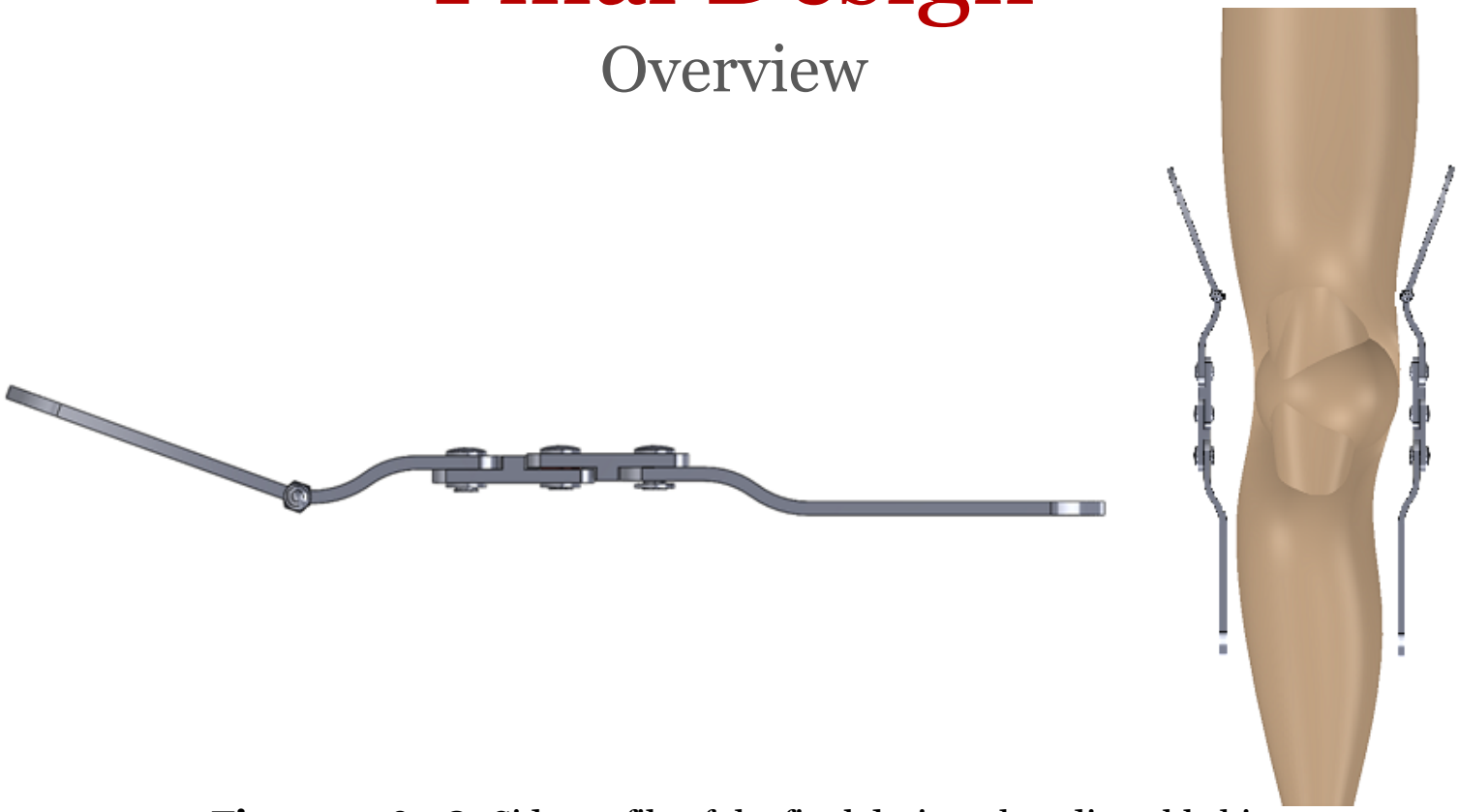


**Figure 17 & 18:** Side profile of the final design: the adjustable hinge.

- Adjustable Hinge
  - Variable arm degree=widest range of patients

# Future Work

- Determine the proper lockable hinge
- Order materials
- Fabricate
- Final testing
  - Tensile testing
  - 3 point bend test
  - Fatigue testing

# Acknowledgements


- Thank you to:
  - Dr. Sarah Kuehl – Project Engineer at Muller
  - Dr. Joseph Towles– Department of BME
  - All of our data subjects
  - UW BME Department

# Questions?

# Sources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