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## Introduction

**Our Mission:** to solve the problem of reliance on patient self-reporting and migration associated with hinged knee braces

**Our Proposed Solution Includes:** a retrofitted angular tracking device (ATD) with a web app interface and a brace support harness

## Clinical Need

- **76.6%** of anterior cruciate ligament (ACL) injuries require surgery and brace usage<sup>1</sup>
- Only **28%** of patients comply with prescribed hinged knee brace usage<sup>3</sup> - **Why?**  
 – **Brace migration from improper fit**



Figure 1: Hinged Knee Brace<sup>2</sup>

- Physicians cannot track usage or recovery progress for patient  
 – **Reliance on patient self-reporting**

**Need:** Device(s) to address issues usage tracking and brace migration for users of hinged knee braces

## Product Testing

### Angular Tracking Device (ATD)

- **Static Test:** Accuracy and precision of ATD
- Test Plan: Use goniometer to measure knee angle and compare to captured data from tracker

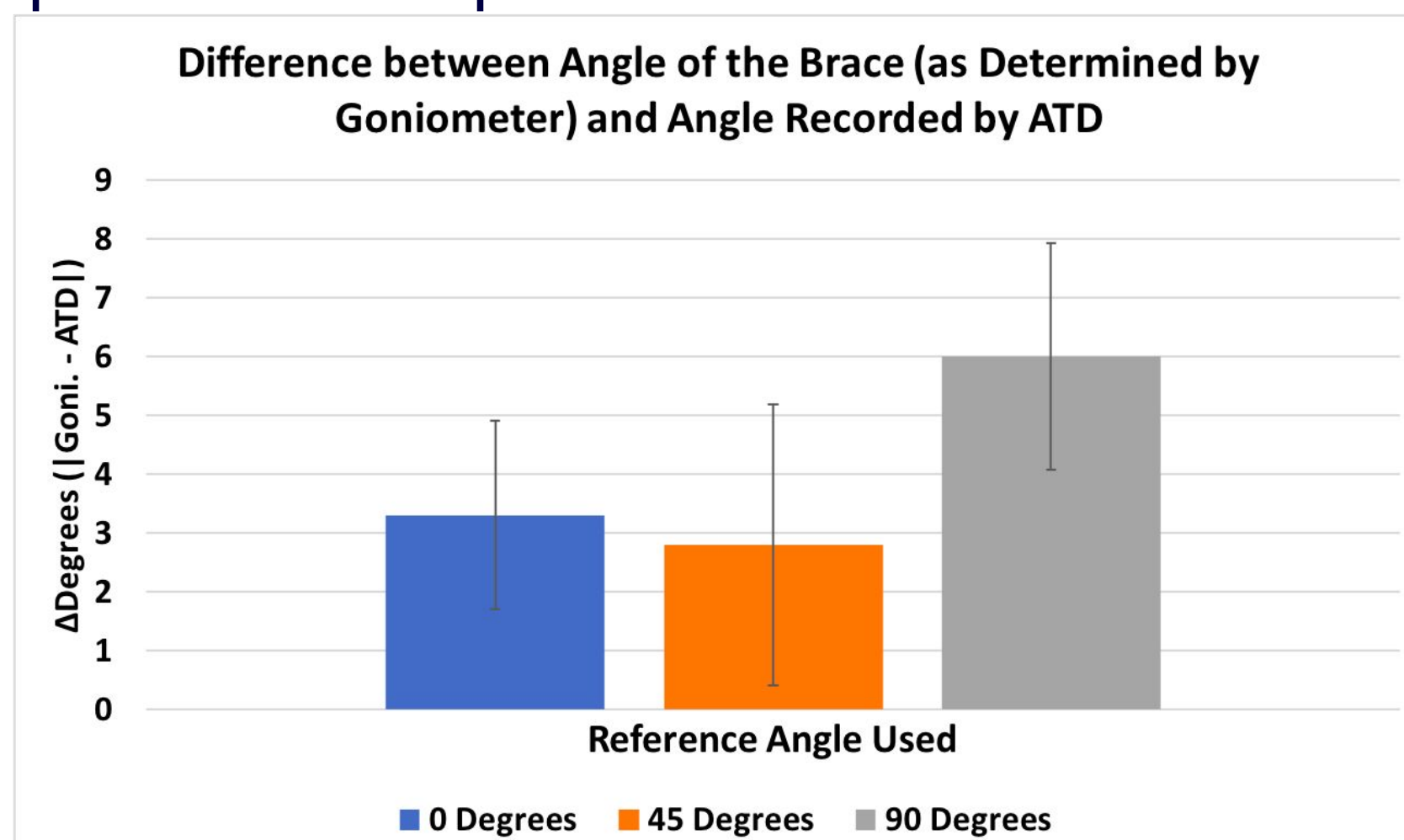


Figure 4: Comparing angle measured by ATD to angle of brace



Figure 5: Static test setup

## Design Overview

### Angular Tracking Device (ATD)

- Low-cost, lightweight Arduino-compatible components
- Knee angle recorded through rotation of a potentiometer attached to the brace hinge
- Electronics housed in a 3D printed case (Lulzbot TAZ 6)
- Graphic User Interface (GUI) available as a MATLAB web app to analyze angle data between days

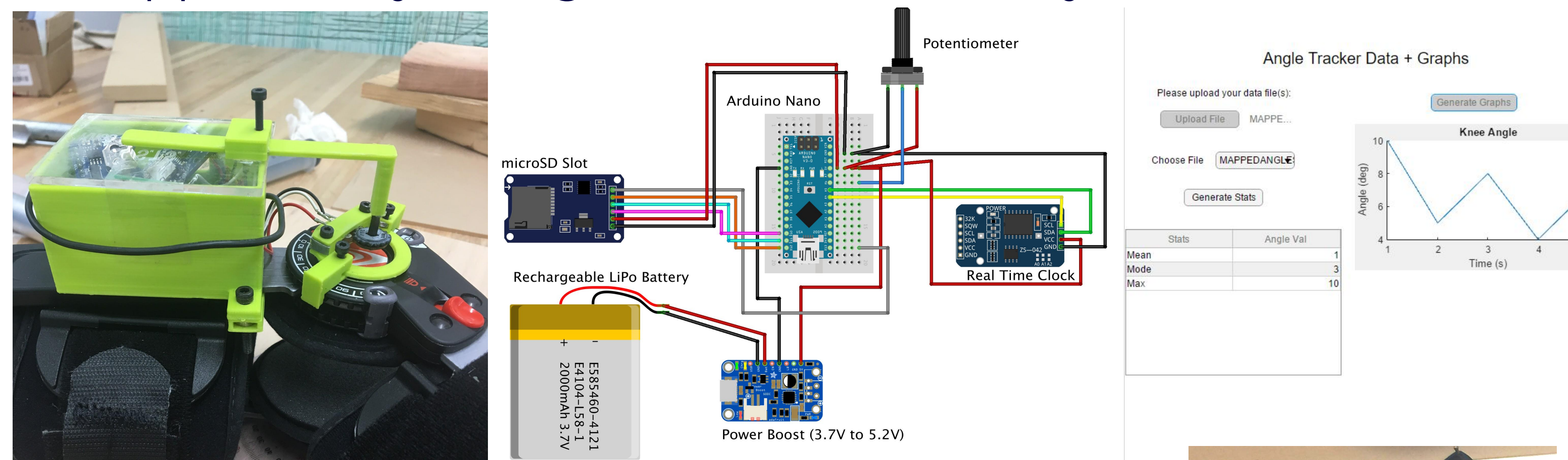


Figure 2: A) ATD side view; B) Schematic of electronics; C) Graphical user interface

### Brace Support Harness (BSH)

- Uses tension to resist downwards migration of the brace
- Connects to the lateral bars of the brace where more weight is located
- Adjustable length allows for better fitting
- Secure attachment for daily use



Figure 3: Overview of the Brace Support Harness

### Brace Support Harness (BSH)

- **Migration Test:** Downward migration of brace
- Test Plan: Mark initial placement (front, side, + back), measure migration over 3 hours (30 minute increments)
- **Theoretical Maximum Slip:** Distance slipped when frictional force is lost and brace is only supported by BSH

### Results:

- Brace migration over time was higher during control tests
- BSH demonstrates potential to hinder brace migration

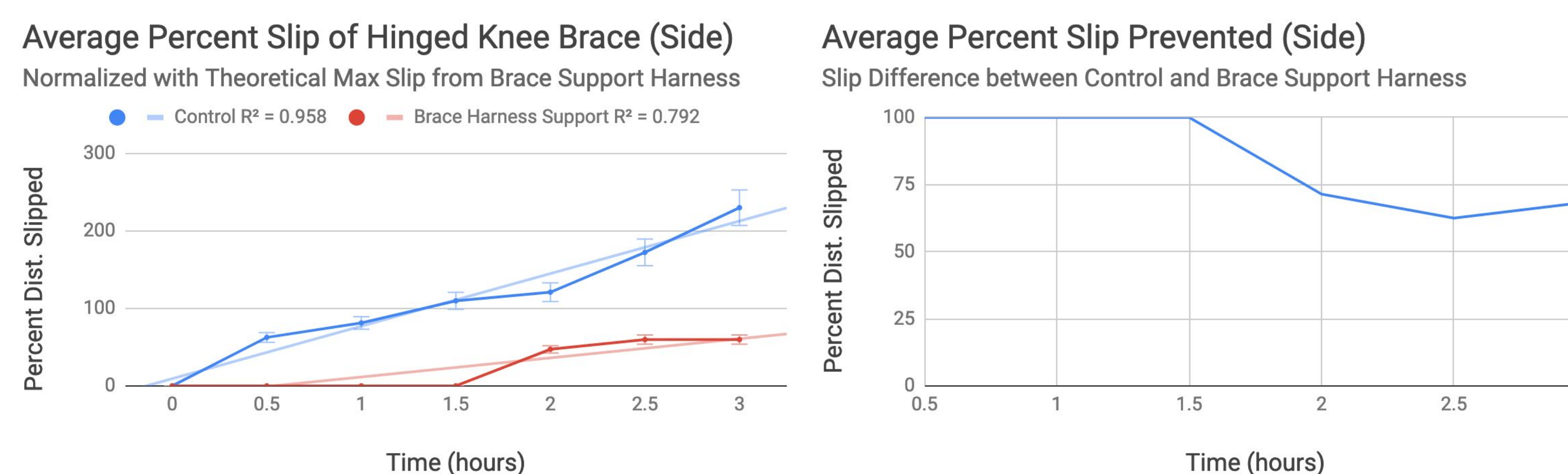


Figure 6: Brace migration as a percentage of theoretical max slip

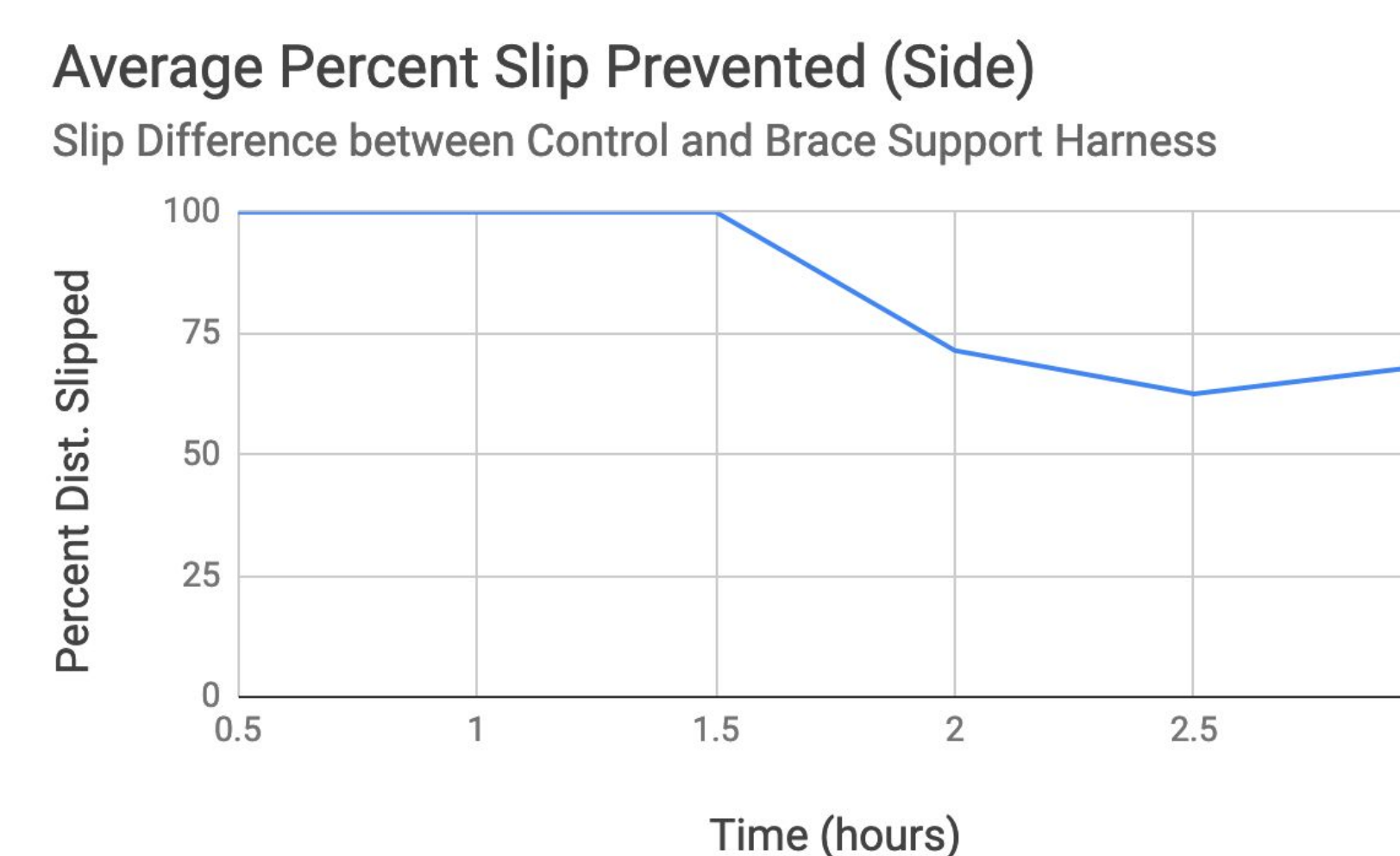


Figure 7: Percentage migration mitigated with the BSH

## Market Analysis

### Market Size and Growth<sup>4</sup>

- Global orthopedics market: \$3.3 billion
- Projected to reach \$5.3 billion by 2025

### Target Market

- Purchasers: hospitals and care centers
- Users: patients using hinged knee braces

### Potential for Reimbursement

- Reimbursable through Medicare and Medicaid with doctor's prescription

## Patentability and Cost

### Patentability<sup>5,6</sup>

- Difficult to patent due to recently published patents in the pipeline

### Manufacturing Costs

- \$112.28 ATD + \$32.99 BSH = \$145.27 Total Cost

Table 1: Overview of Costs

Area of Expenditure	Cost (USD)
Angular Tracking Device (ATD)	
ATD Components*	\$36.00
ATD Case*	\$26.28
MATLAB	\$50.00
Harness	
Suspender Straps	\$10.00
Qualid Posture Corrector	22.99
<b>Total Cost for Single Device</b>	<b>\$145.27</b>

\*Includes cost of tools/consumables used in manufacturing

## Future Work

- Further testing of brace support harness for more conclusive results
- Alternate attachments of harness to brace
- Manufacture the harness as a single unit
- Dynamic testing of the ATD

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