Team Access the Ability

Bunion Correction Strap

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iStock, 2024

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The Problem

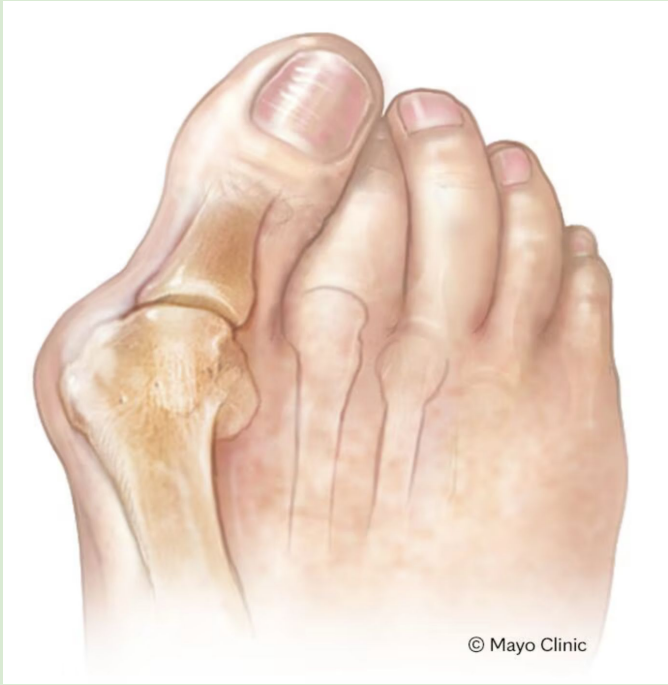
1 and 3 Americans are affected by bunions.

Symptoms include:

- Swelling
- Pain
- Difficulty walking

Current options on the market:

- Icing
- Spacing inserts
- Pain medication

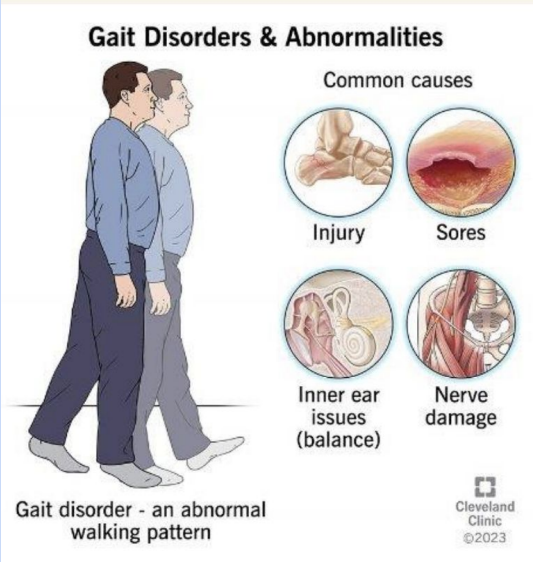


There lacks a solution that is accessible, low cost, and corrective. Our project has set out to provide a solution for users that will alleviate their bunions.

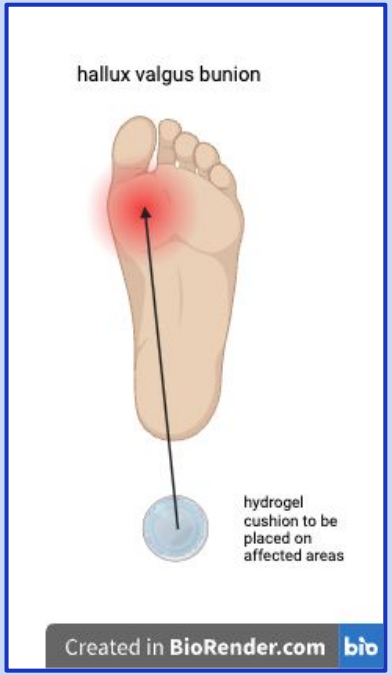
The goal of our product and our journey throughout the process:

We started out aiming to fix gait abnormality, then honed into specifically treating bunions

We then created a prototype for a bunion correcting device that will incrementally adjust the users toe over time towards alignment



Ideation process



User needs:

Based off of our Traceability Matrix, we honed in and ensured we were meeting our user needs:

Customer requirements:

We will go more into detail when discussing design considerations, however we wanted to ensure our product hit three main requirements:

1. **Adjustability**
2. **Low cost**
3. **Potential for correction**

Product performance:

- Durable
- Elastic allows for ease of movement
- Velcro or clasps do not become undone

Biocompatibility requirements:

- Device should not lead to discomfort for the user
- Device should be capable of being worn for long periods of time without adverse effects such as friction, cut off circulation, or irritation

Concept Selection

	Criteria	Weight (1-5) 1-least important, 5-most important	Bunion Corrector	Surgery	Foot Braces	Toe Spacers	Physical Therapy/ Use of exercises	Toe Splints / Correctors	Footwear modifications (e.g. wedge, split sole, etc.)	Bunion Pads and Cushions	Orthotic Inserts	Totals	Rank
				1				2	3	4	5		
				Alternatives									
1	Low cost	4	0	–	–	+	0	+	+	+	+	3	3
2	Reliability, Durable	5	0	+	+	0	+	+	0	+	0	3	2
3	Safe/Risk Free/Breathability/Biocompatibility	5	0	–	+	+	+	+	+	+	+	3	3
4	Comfort during correction	5	0	–	+	+	+	+	+	+	+	3	3
5	Lightweight	3	0	–	–	+	–	+	0	+	0	1	8
6	Adjustability / Ease of Use	2	0	–	–	+	–	+	+	+	+	3	3
7	Support/Stability	5	0	+	+	+	+	+	+	–	0	2	7
8	Corrective Function	5	0	+	+	–	+	0	–	–	–	-2	9
9	Fashionable/ Low Profile	1	0	+	–	+	0	+	+	+	+	5	1
			Totals	-3	15	20	20	30	17	15	12		
			Rank	8	5	2	2	1	4	5	7		

Splints/Correctors

Spacer

Design considerations:

Durability: This product should withstand wear and tear and not break or degrade.

- Product material composition
- Comfort

Adjustability: This product needs to be adjustable to allow users to incrementally move their toe closer to 0 degrees (alignment).

- Utilizing a system to quantify progress

Cost effective: This product should be low cost, to maximize accessibility.

- We want a solution brings users an effective alternative without the cost of surgery

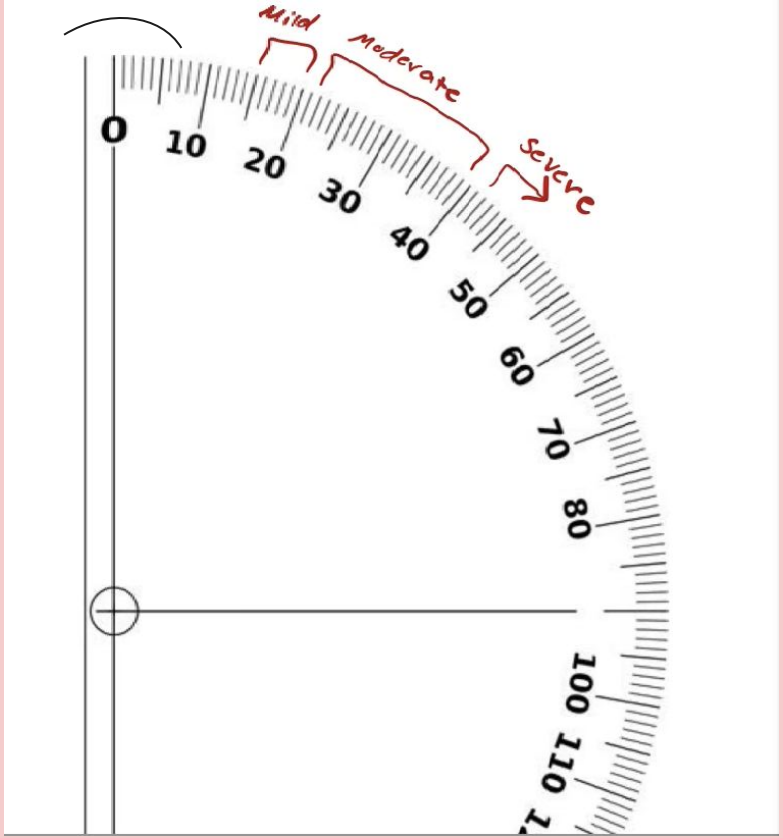


Diagram for use on the right foot

Initial Idea

- Features:
  - Sock Sleeve
    - Hydrogel bunion cushion(s)
    - Adjustable Velcro strap
    - Elastic band
    - CAD designed and 3D printed wheel component with angle indication

  Proof of concept: laser cut wheel

Fabrication

Elastic band sewed onto sock grasping big toe

Velcro Mechanism

Strap Adjusting Mechanism

Bra Hook Extender Mechanism

Hydrogel cushion insertion

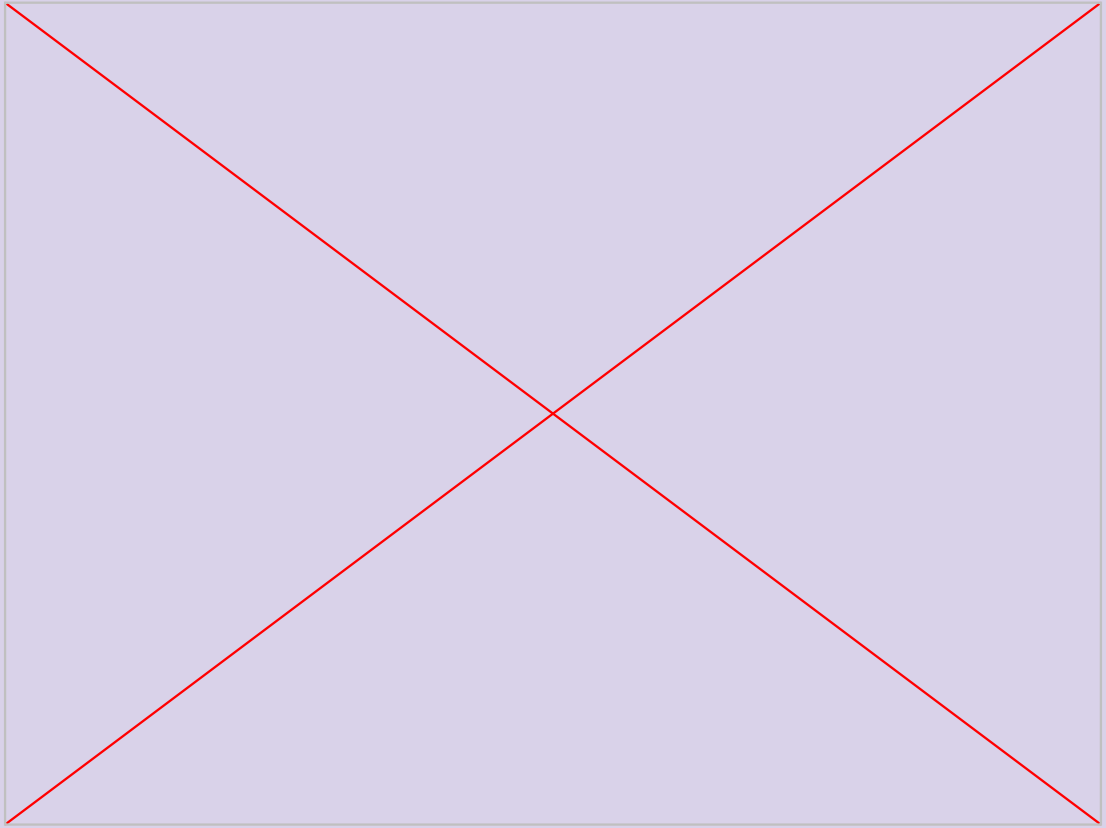
Final Prototype

Front View

Side View

Back View

Final Prototype Tutorial For Bunion Correction Strap

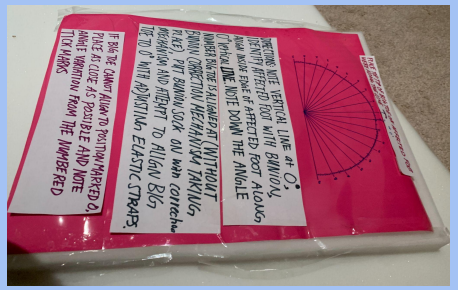


But wait.... There's more

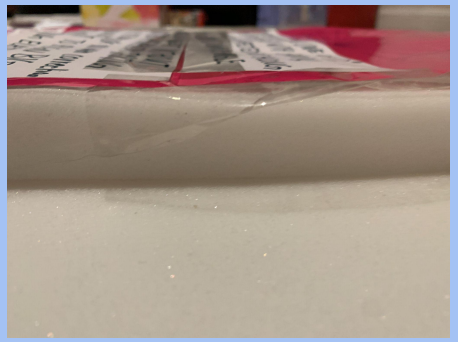
Featuring a Heat Sensitive Mat for Self Marking Bunion Corrections

Using the Mat

Top Side View

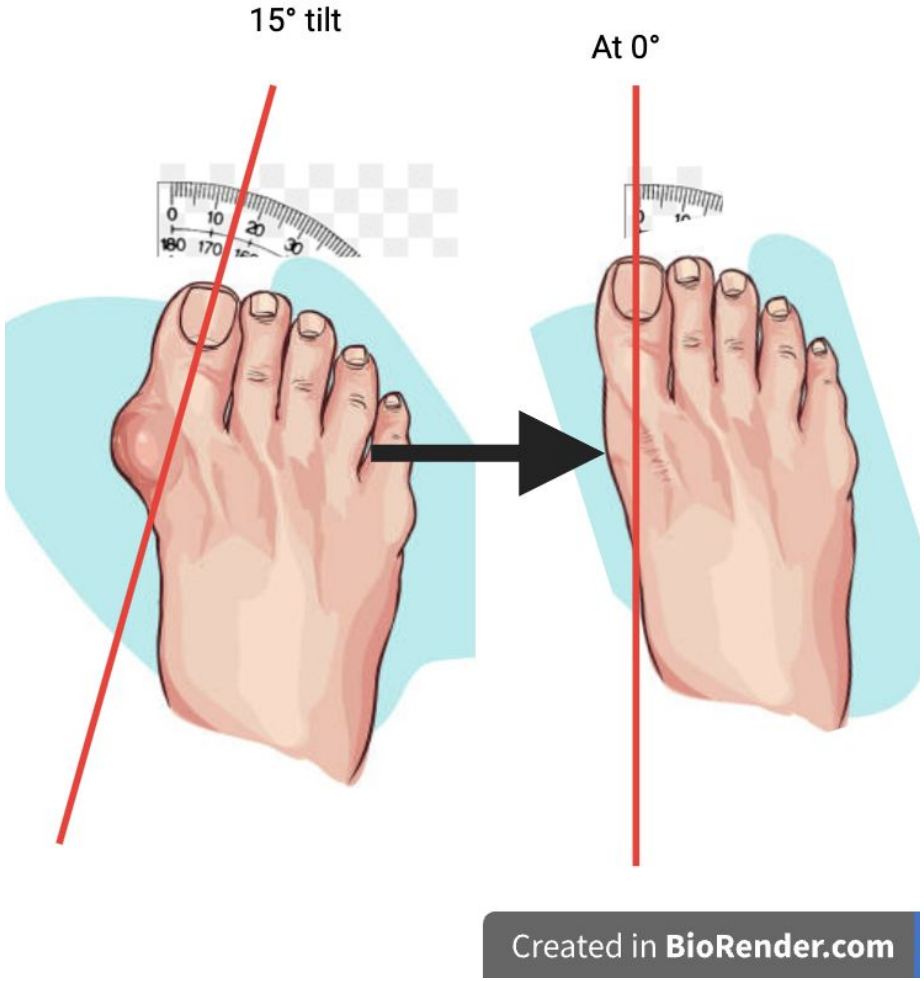


Top View



Side View

Before Correction


15° tilt
At 0°
Created in BioRender.com

User Manual

How To Use It

STEP 1 Place a sock (not included with product) on foot affected with hallux valgus

STEP 2 Wrap white elastic strap around ankle and tighten with velcro

STEP 3 Hook access material to any of the rings of your preferred fit setting

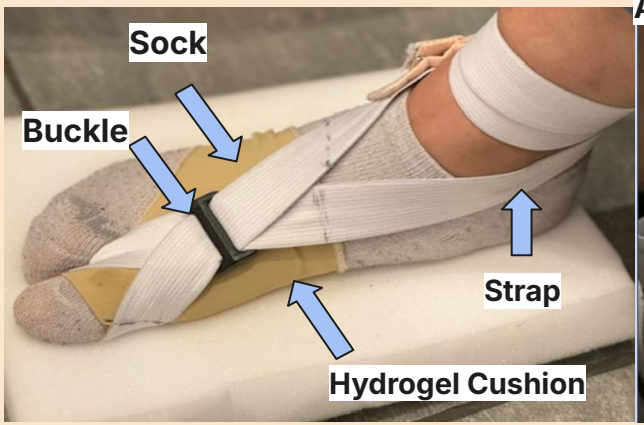
STEP 4 Slide buckle closer to the big toe to loosen strap; Slide buckle further to tighten strap

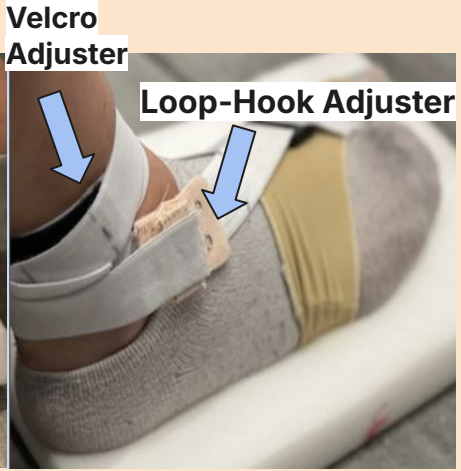
5. **STEP 5** Place foot on heat transfer mat, aligning big toe with the designated marking on mat (for longer feedback duration microwave sock 1 min under 800-1000 watts)

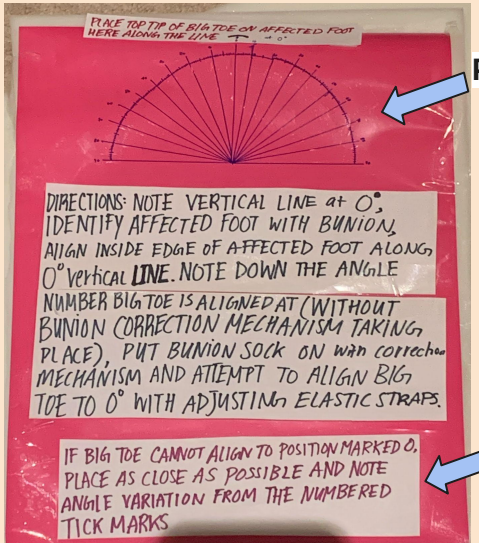
6. **STEP 6** Read angle of big toe and adjust 1-3 degrees per week of current toe orientation based on comfortability

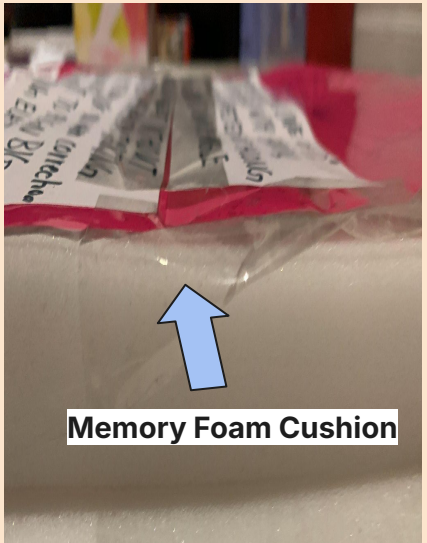
Goal: 0 degrees orientation of big toe

Warnings:
TIGHTENING ANGLE MORE THAN DESIGNATED AMOUNT MAY LEAD TO FURTHER DEFORMITY! DO NOT INGEST! REMOVE BUCKLE BEFORE WASHING & DRYING!









Projected Impact

Clinical evaluations of similar technologies:

“79% of patients observed a realignment of their big toe after 1 month of use of the day bunion corrector and 92% with the night bunion splint.”

“More Wear More Results” - Macy Halim

“Our goal is completely straight 0 degree toe alignment!” - Team Yellow

“We anticipate users to observe results after 1 month if they consistently and correctly use device!” - Team Yellow

Validation & Verification

User needs met 🤠

100% of the trials, toe remained in place with tightened buckle ✅

100% of the trials, toe shifted in relation to buckle adjustments ✅

Universal fit for women US sizes 6-9, more sizes coming soon ✅

Comfortable by users through activities: sitting, lying down, walking, exercising ✅

Able to fit inside standard shoes with little to no visibility ✅

Limitations to our device:

Scalability:

- Our device was handmade, and if we were to produce this product we would need a faster way of production
- Portions were handsewn, methods would have to be developed to scale up and automate

Limited use for severe cases:

- Our device is meant to treat mild and moderate bunions, however severe bunions may need more invasive solutions such as surgery

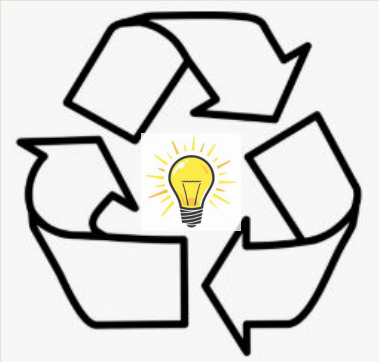
Competition with established solutions:

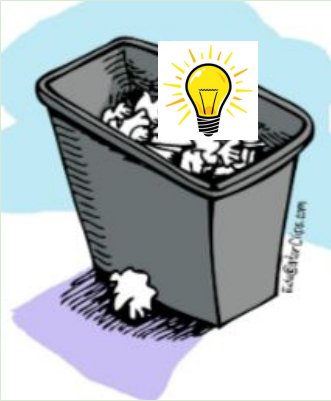
- Due to the high prevalence of bunions, there are currently many methods on the market to treat them. Our product would need to gain a share in the current market and convince customers to buy

Address practicality of heat sensitive mat:

- Adjust longevity of heat color change mat to ~24 hours so foot imprintment can be seen until next day's adjustment

What we've learned throughout this journey





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