

Design Challenge

Solution

Background:

Clubfoot is a physical deformity in which an infant is born with one or both feet turned inward. While occurring in 1/1000 births¹, clubfoot is treatable through bracing.



Figure 1: The feet of a child born with clubfoot.

The most widely-used treatment method is the Ponseti Boots and Bar, which connects both feet together and holds them at a specific angle.



Figure 2: The Ponseti boots and bar.

Treatment:

Casting
(2 months)

Tenotomy
(cutting Achilles tendon)

Bracing with boots and bar
(~5 years)

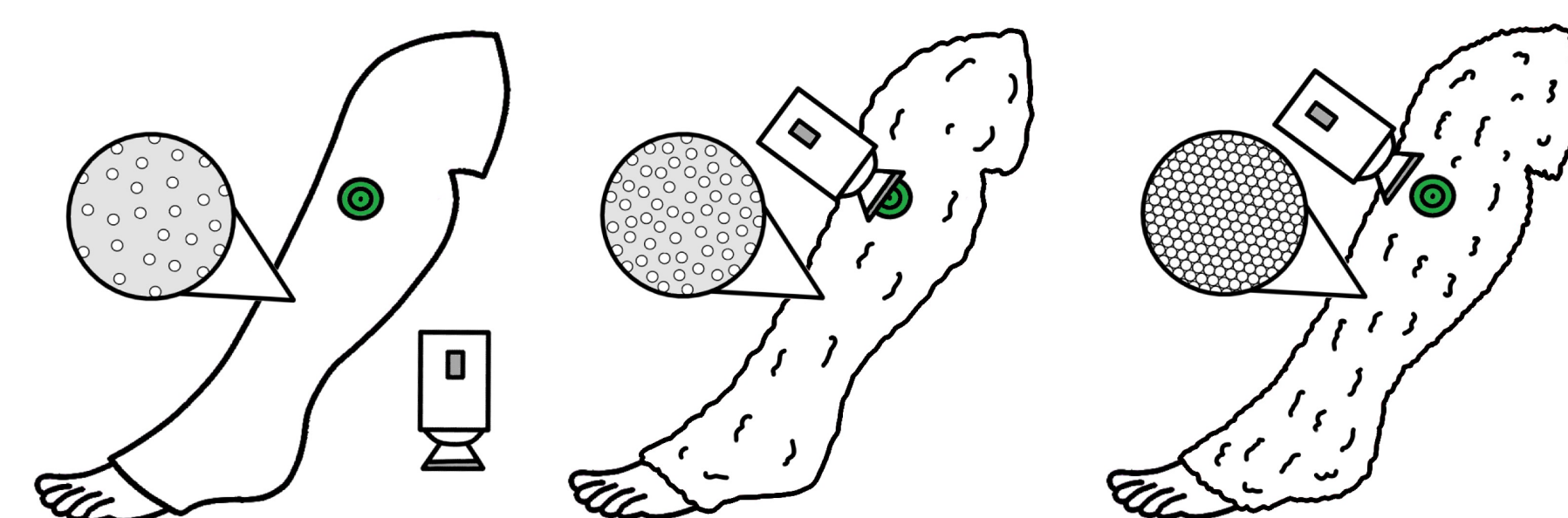
Key insights from parents and clinicians:

- Boots & bar brace is very effective at holding the correct angle.
- Kids can't roll over at night due to the bar and will wake up screaming and afraid.
- Boots and bar are loud and startle kids if they hit a crib wall.
- Difficulties with wearing boots and bar at night leads to non-compliance in bracing and increased risk of relapse.

"She wakes up every 1.5-2 hours. We're not getting any sleep."

Team Need Statement: Children with clubfoot need a way to move their legs independently to increase compliance with wearing their brace.

Our design consists of a "sock" filled with polystyrene beads that the user hardens into a brace by pumping the air out of the sock.



Alignment Mat

Each brace comes with an alignment mat which allows parents to set the angle of their child's affected foot at home before removing air from the sock.

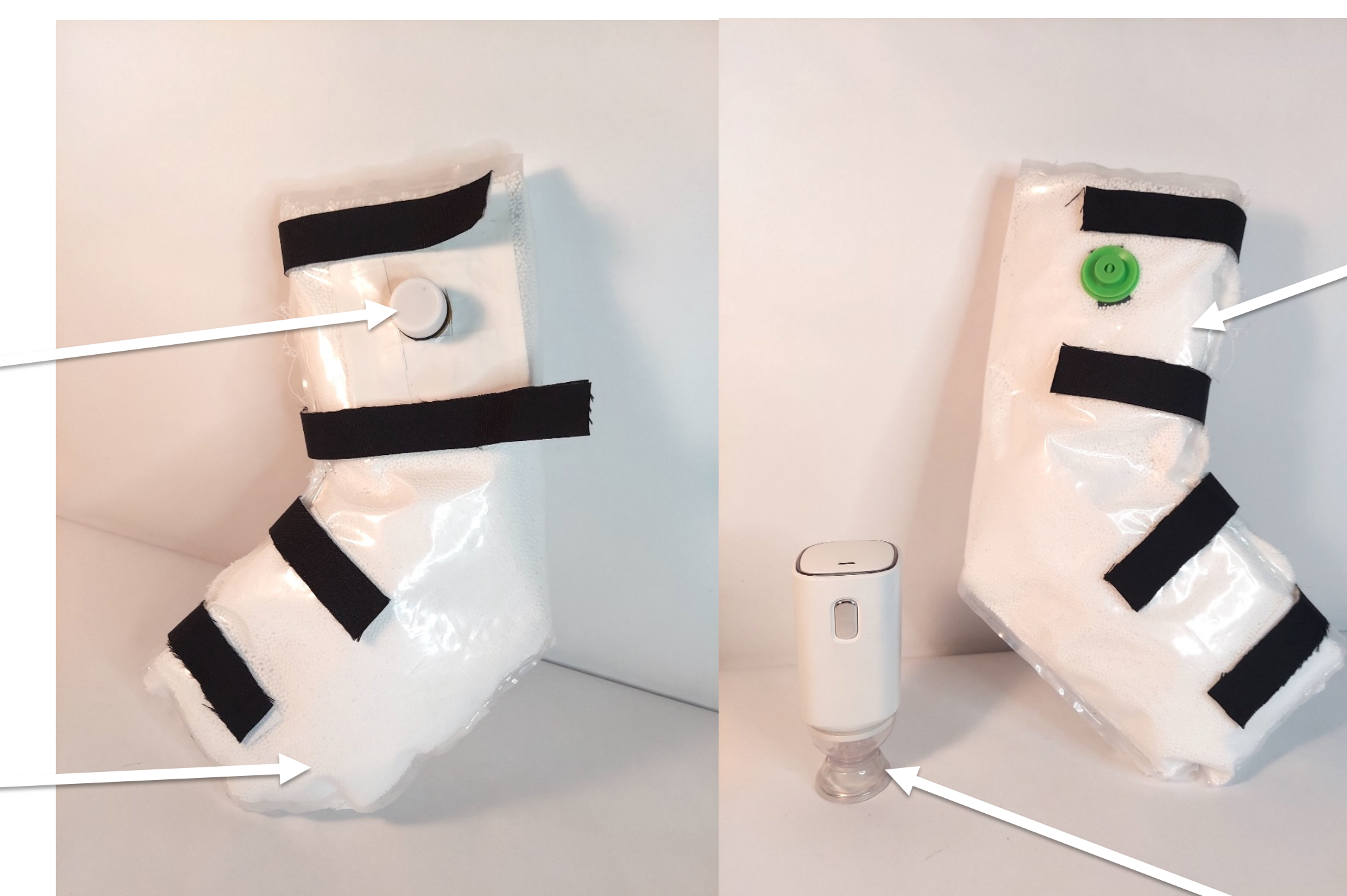


Inflation valve allows air back into the system to remove brace

Polystyrene beads compact under vacuum to form a stiff yet lightweight shell

Secure Ankle Angle is set using the alignment mat and holds for ~12 hours

Independent Leg Motion for greater comfort and freedom



1-Way Suction valve to remove air from the sock and seal in position

Electronic hand pump pulls air through the 1-way valve

Removable soft vinyl ensures that the inside of the brace is comfortable and that the material can be washed



Development Journey

1. Shaped brace with vacuum

We were able to shape the brace to the foot and ankle using a heat sealer. The prototype hardened effectively for an hour.



2. Shaped brace with additional release valve

This prototype better formed to the foot, was easier to manually soften due to the addition of a release valve and held its stiffness for a couple of hours.

Removable, washable soft vinyl inner liner to reduce the risk of puncturing the sock

Fuzzy sock outer liner with animal to ensure comfort and kid-friendliness



Aesthetic Model



Mat prototype

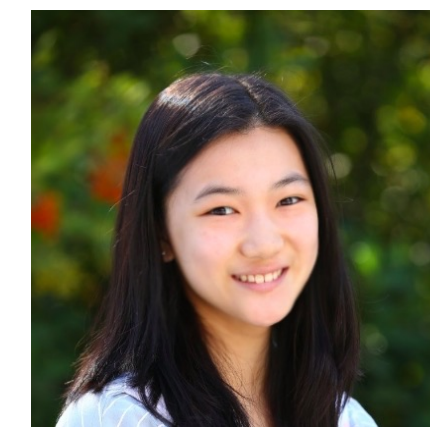
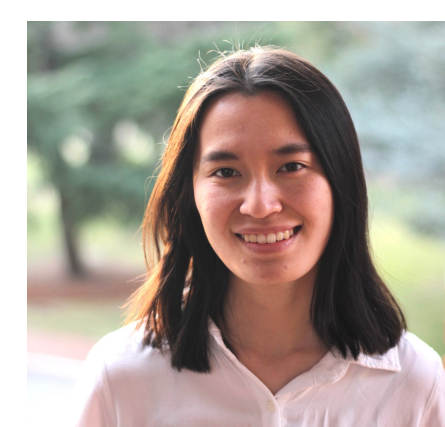
The mat was designed in CAD and 3D printed. The yellow disks can rotate to align at a certain angle relative to each other.

Meet the Team

Jenlu Pagnotta

Hannah Yamagata

Delphine Tan



Project Video

Scan QR code to view our short project video.

