

P III

DESIGN INTERVENTION FOR
CLUB-FOOT ABDUCTION
ORTHOSIS



IDC School of Design

Guided by

Prof. Avinash Shende

Presented by

Rajat

176130006

What is Clubfoot?

Clubfoot is a deformity in which an infant's foot is turned inward, often so severely that the bottom of the foot faces sideways or even upward.

The clubfoot can affect one foot or both feet.

Cause of Clubfoot

Genetic & Environmental factors are considered responsible.



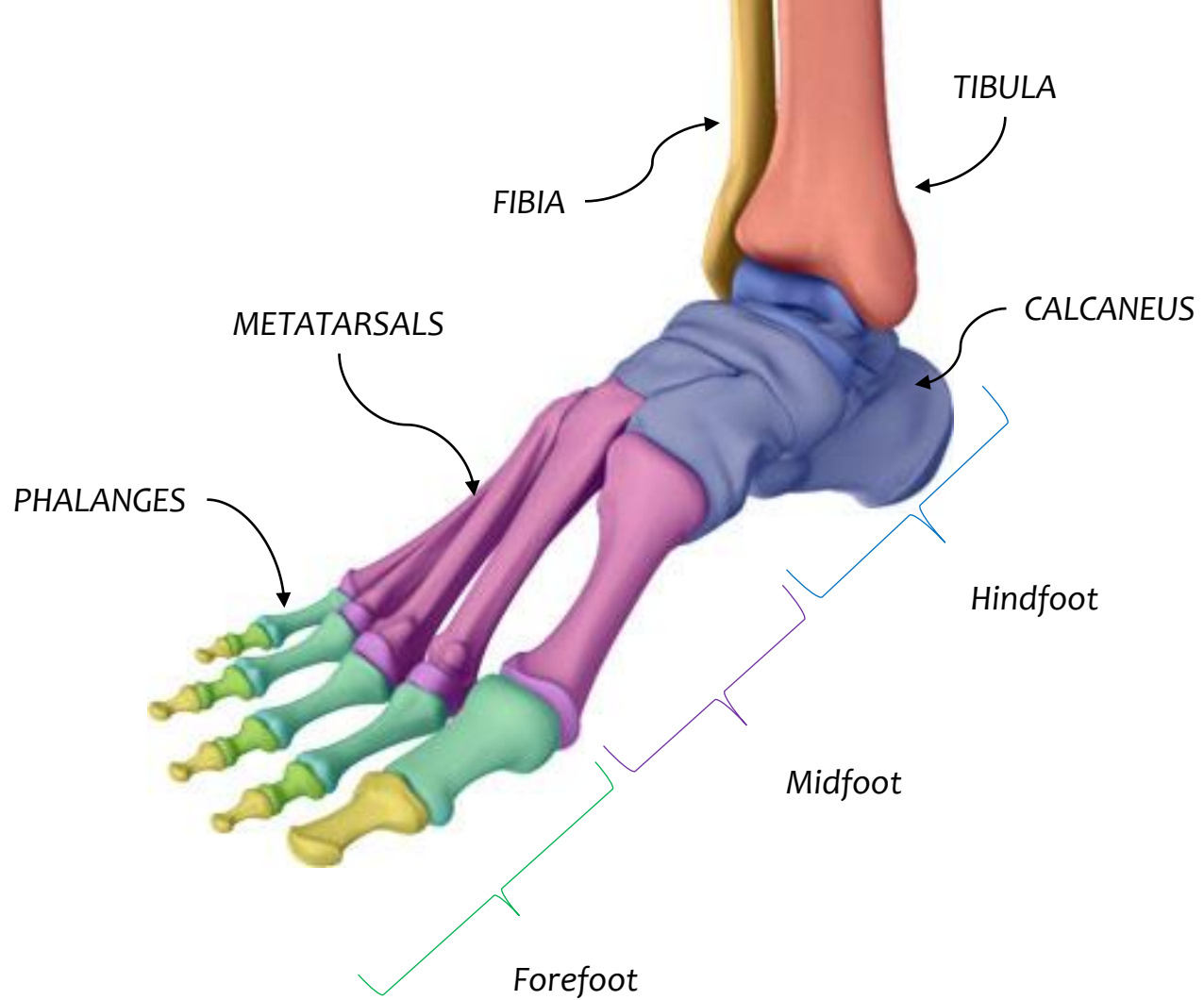


FIG. NORMAL FOOT ANATOMY

https://www.fyzical.com/boerne/media/img/351574/clubfoot_intro01.jpg

BASIC FOOT ANATOMY

Clubfoot & Normal Foot

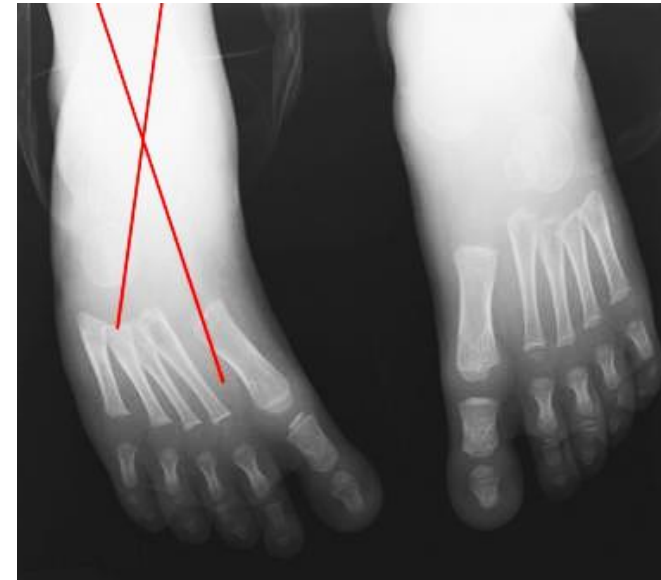


FIG. X-RAY OF FEET WITH UNILATERAL CLUBFOOT

<https://emedicine.medscape.com/article/407294-overview>



**World Health
Organization**

Clubfoot affects

1 lakh

*children worldwide, making it one of the most common birth
defects in the world*

80%

of untreated clubfoot are found in developing countries




What if untreated ?

Regardless of the type or severity, clubfoot will not improve without treatment

A child with an untreated clubfoot

- *Will walk on the outer edge of the foot*
- *Develops painful calluses*
- *Faces difficulties in wearing foot wears*
- *Have lifelong painful feet that often severely limit activity*



A man with dark hair and a mustache, wearing a white shirt with thin pink and blue vertical stripes, is seated at a wooden table. He is operating a vintage-style manual sewing machine. His hands are positioned to guide a piece of yellow fabric through the machine. The room has a plain, light-colored wall and a dark floor. A large, crumpled piece of yellow fabric lies on the floor to the right of the sewing machine. The lighting is somewhat dim, creating a somber atmosphere.

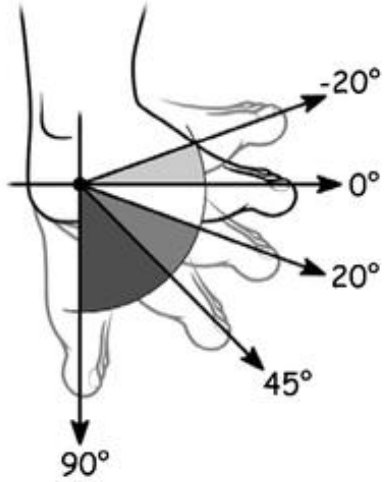
*Can be corrected at an early stage
and becomes difficult to treat if neglected!*

Then

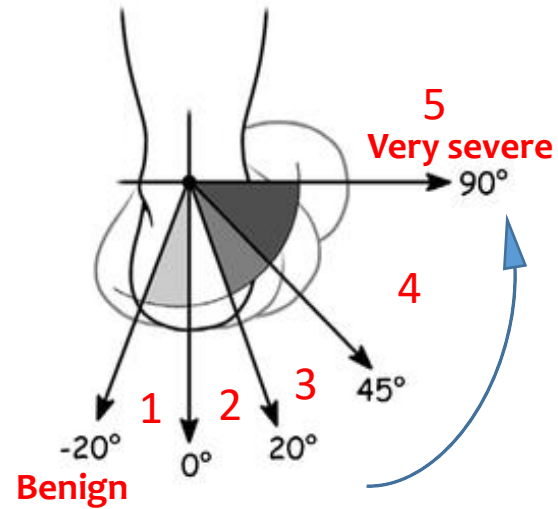
EMPLOYMENT & SOCIAL STIGMAS

*are life challenges especially in underdeveloped
countries...*

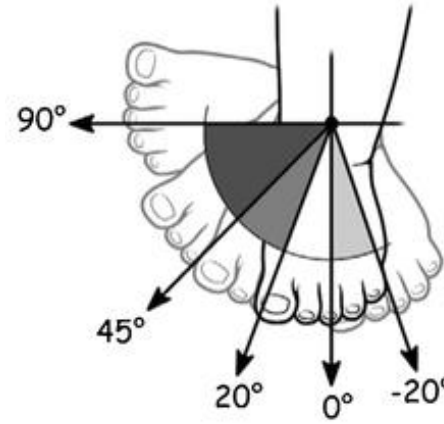
GRADE OF CLUBFOOT



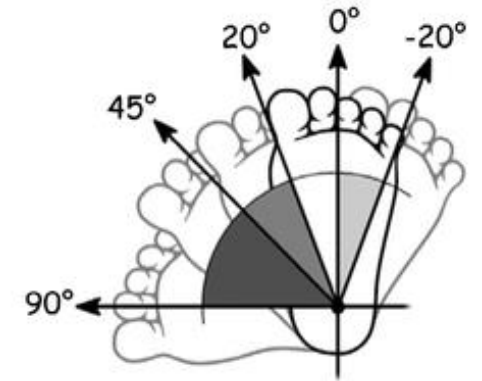
LOOKING FROM RIGHT
HAND SIDE
OF LEFT FOOT



LOOKING FROM BACK
OF LEFT FOOT



LOOKING FROM TOP
OF LEFT FOOT



LOOKING FROM BOTTOM
OF LEFT FOOT

GRADE CLASSIFICATION

GRADE	TYPE	SCORE
1	BENIGN	<5
2	MODERATE	=5<10
3	SEVERE	=10<15
4	VERY SEVERE	=15<20

TABLE: GRADE CLASSIFICATION

TREATMENT OF CLUBFOOT



1

Ponseti Method

Most clinically practised and efficient method.



2

French Method

*This incorporates stretching, mobilization, and taping.
Done by a physical therapist who has specialized training and experience.*



3

Surgery

In cases, severe deformities that do not respond to stretching, surgery may be needed to adjust the tendons, ligaments, and joints in the foot and ankle.

Ponseti Method

*The Ponseti method is a non-invasive, low-cost procedure to correct clubfoot with a **98%** success rate.*

It consists of manually aligning the child's foot with the application of a series of casts.



FIG. Series of casts over 4 to 6 weeks

- **Complete Correction is achieved by Casts Only.**
- **Braces are used to Hold or overcorrect the foot to avoid any recurrence.**

TENOTOMY

**Small Blade Insertion
to cut**

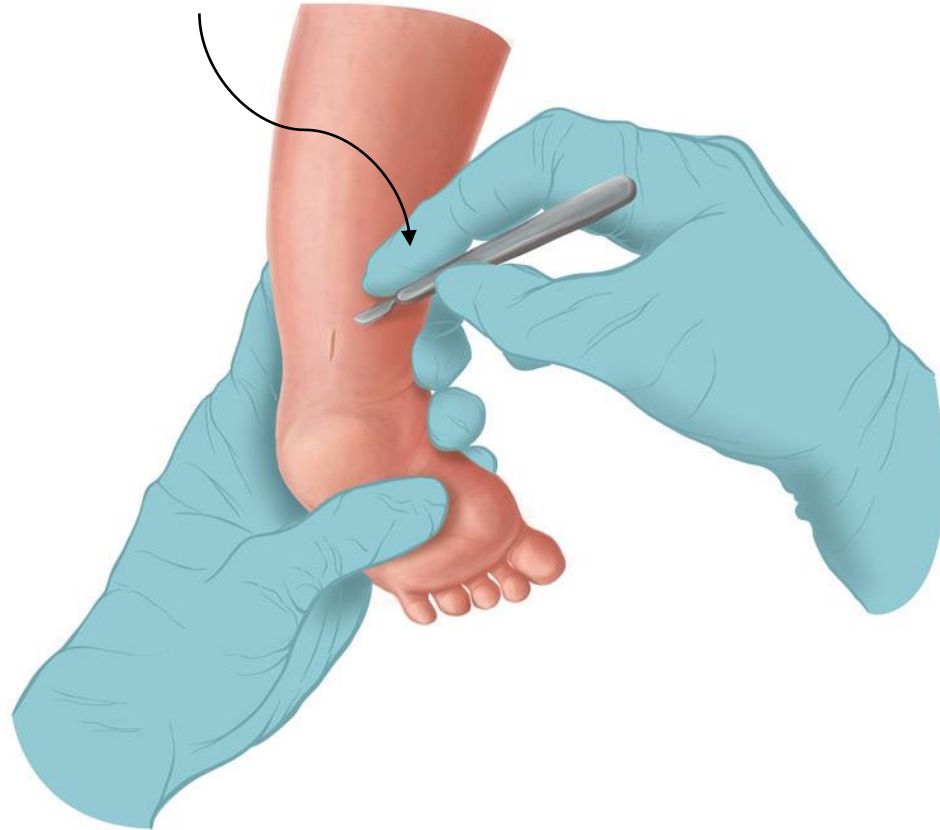


FIG. TENOTOMY

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Achilles Tendon

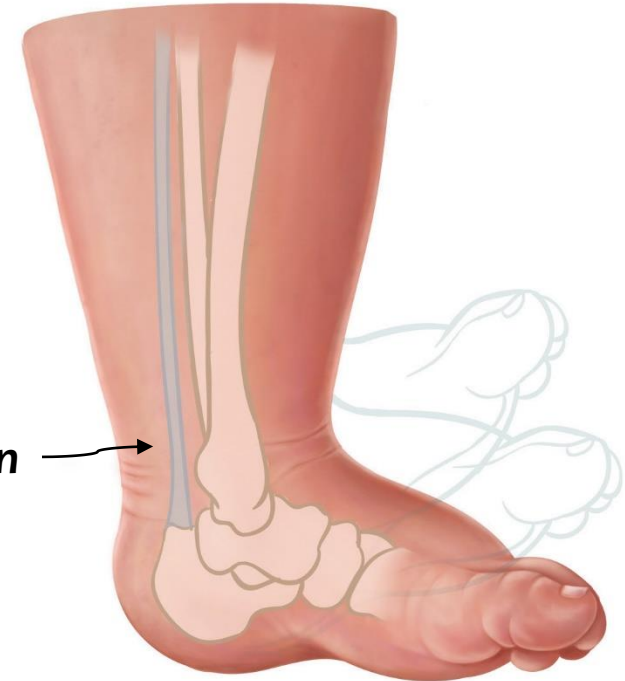
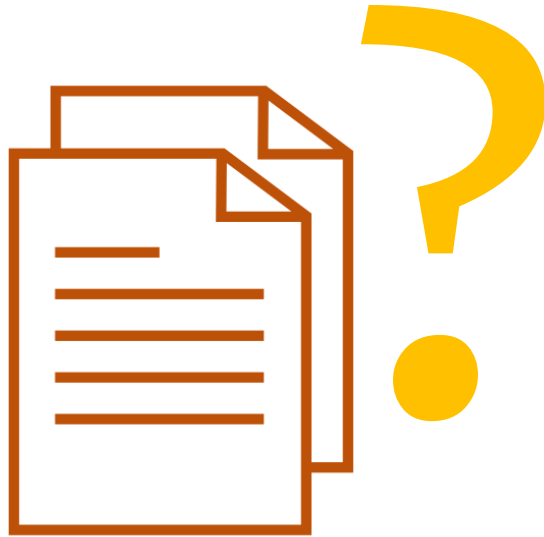


FIG. ACHILLES TENDON

https://pro2-bar-s3-cdn-cf1.myportfolio.com/4c4c5b43d9721670b083172df179a66d/2fb8c845370215.582e157e94e1c_car_1x1.jpg?h=bc5f656a6cd4fbcco5678a05f58260fo

FIELD VISITS & USER STUDY



Creating Questionnaire



A basic questionnaire was made prior meeting the expert Doctors based on the initial theoretical enquiry about the Clubfoot-

- *For a quick and focussed overview of clubfoot as a phenomenon.*
- *To understand the practicality of present solutions and treatments.*

Visiting Doctors



DR. NISHA

CMO
IIT-B HOSPITAL



DR. ATUL BHASKAR

Visiting consultant
HIRANANDANI HOSPITAL



DR. BHUSHAN

Asst. Paediatric Specialist
HIRANANDANI HOSPITAL



DR. SOURABH SINHA

Visiting Consultant
BETIC, IIT-B



DR. ALERIC & TEAM

Paediatric Specialist
B J WADIA HOSPITAL, PAREL



DR. SURESH CHAND

Asst. Paediatric Specialist
B J WADIA HOSPITAL, PAREL

USER 1

CLINIC – Children's Orthopaedic Clinic

CLINICIAN – Dr Atul Bhaskar

LOCATION - Andheri West.

AGE – 24 days old

CONDITION – Unilateral Clubfoot [Right]

**Holding the leg at toe
and knee**



**Start from the foot by
holding it in a desired
way**



**2-3 layers are casted one
by one**



Done !



USER 2

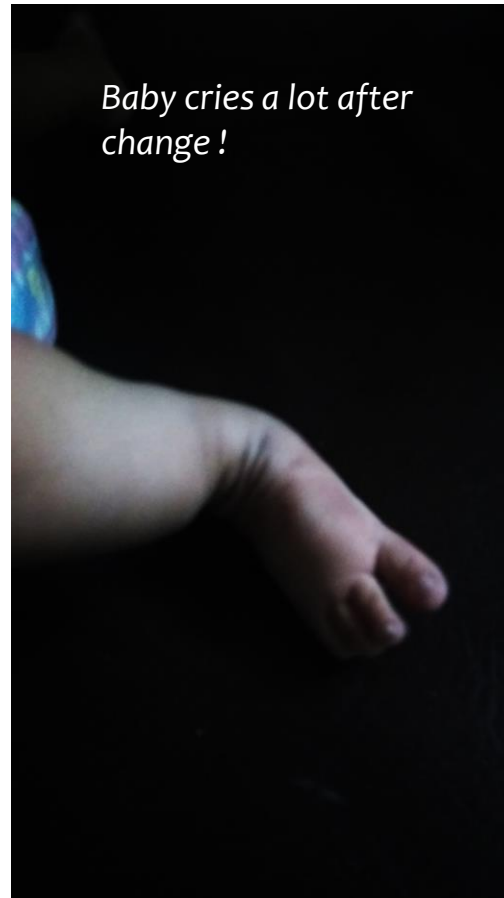
CLINIC – Children's Orthopaedic Clinic

CLINICIAN – Dr Atul Bhaskar

LOCATION -- Andheri West.

AGE – 8 months old

CONDITION – Bilateral Clubfoot [Both Left & Right foot]





USER 3

CLINIC – Clubfoot clinic at B J
WADIA Hospital
CLINICIAN – Dr Alaric Arijoos
LOCATION -- Parel.
AGE – 8 yrs. Old
CONDITION – Relapse of
Clubfoot [Left]



USER 4

LOCATION – Bangalore
AGE – 25 years
CONDITION – Bilateral Clubfoot

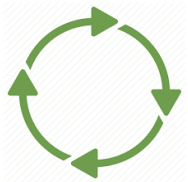
Key Insights



- Any kind of **leniency** in bracing can lead to relapse.



- Child takes around **a week to adjust to the brace** once the bracing protocol starts.



- **Braces are circulated among the patients** either when parents cannot afford the treatment or the no. of braces available is less.



- **Visual inspection of exposed foot is must** to avoid/realise any kind of damage/problems in plastered or braced foot.



STUDYING
EXISTING ORTHOSIS

Ankle Foot Orthosis

[AFO]

- Costs around Rs. 400 -800.
- It Is Globally Used.



FIG. AOF ORTHOSIS

Stanford Orthosis

- Costs around \$ 25.
- Under Pilot for testing and observation.



FIG. STANFORD ORTHOSIS

Steinbeek Orthosis

- Costs around Rs 1000
- It Is globally used and is well accepted by clinicians



FIG. STEIN BEEK ORTHOSIS

The Denis Browne Bar

- Costs around \$ 100.
- It Is Very Popularly used in UK

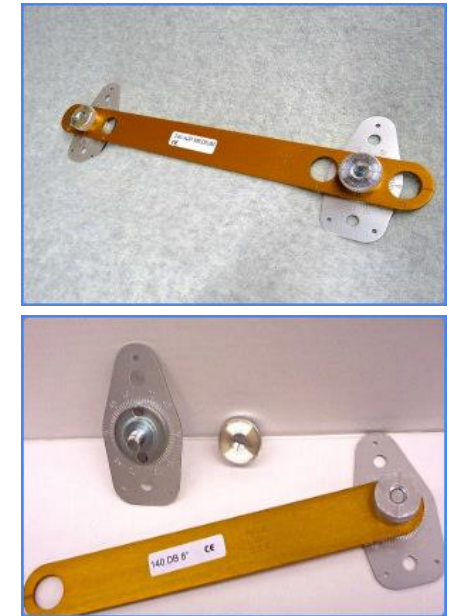


FIG. DENIS BROWN BAR

Iowa Orthosis



FIG. IOWA BAR

- Costs around 200 \$
- Its is popularly used in China & US

Dobb's Orthosis



FIG. DOBB'S BAR

- Its is popularly used in Canada, UK, Brazil & Japan.
- The brace itself cost around 120 \$.

MARKELL SHOES
BY
MARKELL SHOE COMPANY



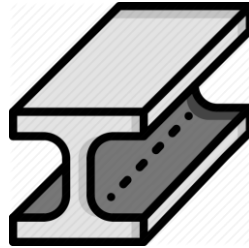
FIG. MARKELL SHOE

- This braces are to be wore with Markell's shoes which costs around \$ 100.

Key Insights



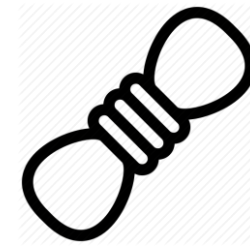
With the **increasing size of brace**, it becomes **less portable**.



Metallic and edgy braces are difficult to handle.



Any sort of **exposed joinery is unsafe** for growing kids.



Lacing the shoe is **time taking and often needs assistance**.

Product Positioning

The area, shaded inside the red lines, indicates a niche for the desired orthosis.

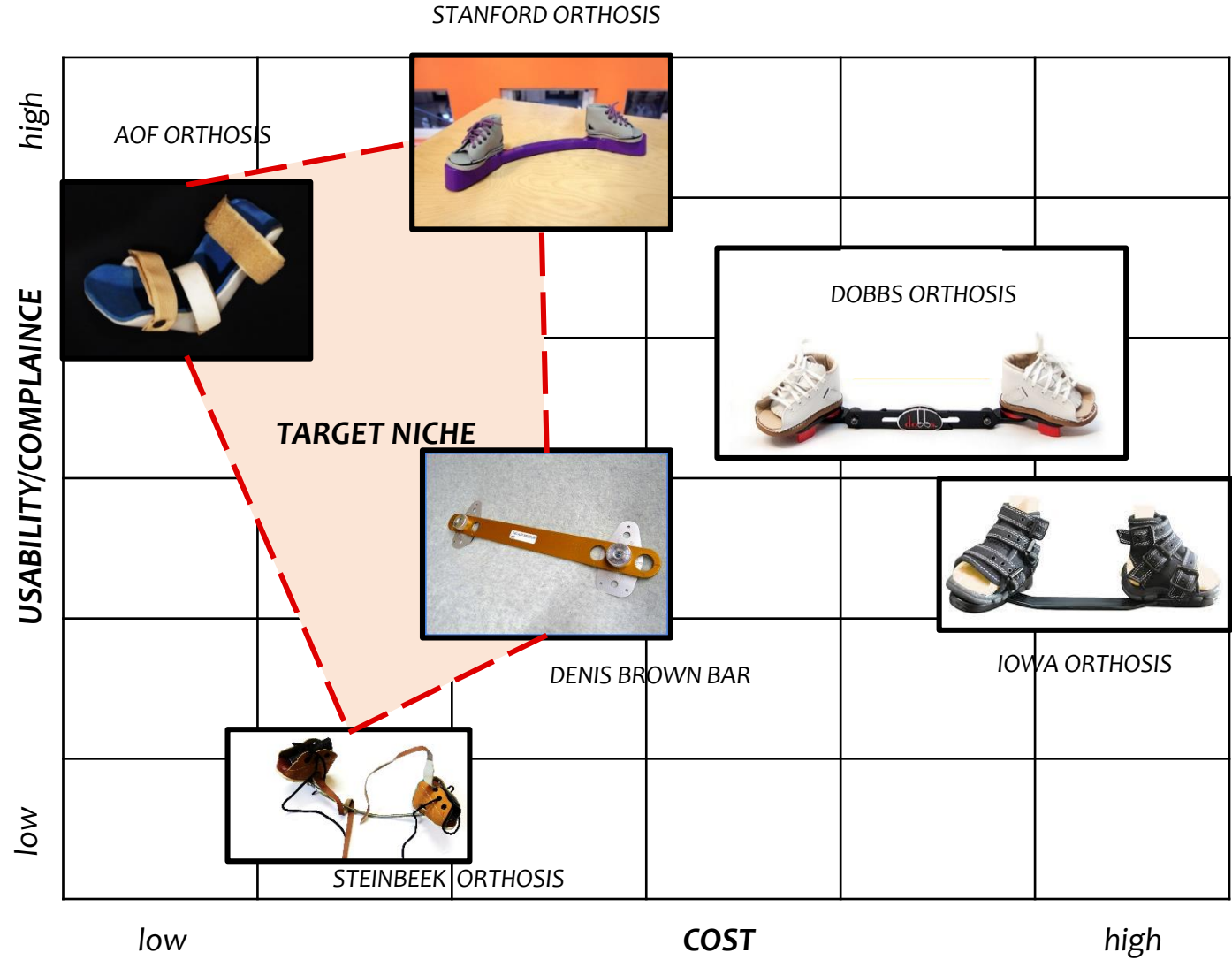


FIG. PRODUCT POSITIONING

Product Positioning

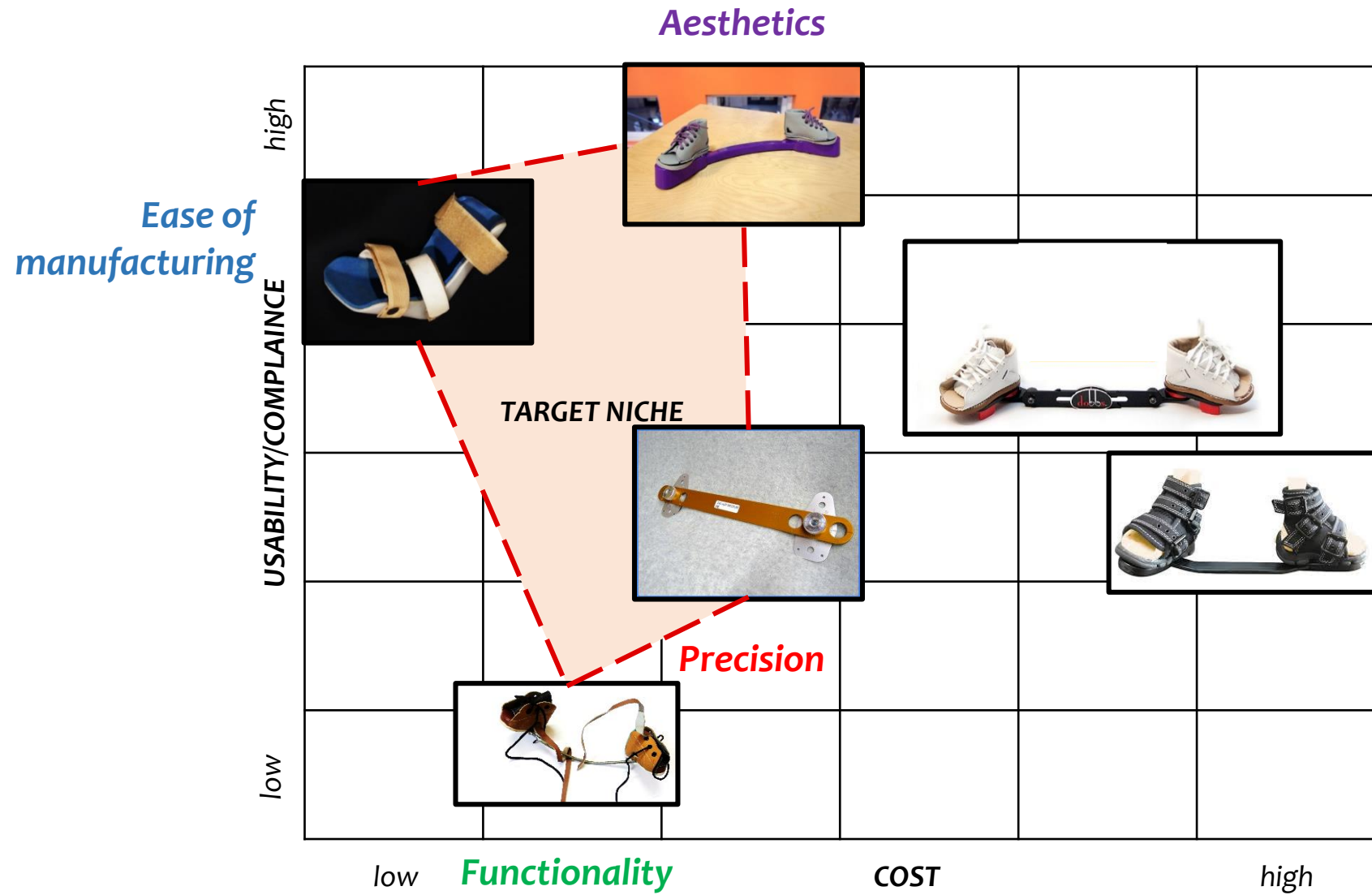


FIG. PRODUCT POSITIONING



USER PRODUCT INTERACTION



Another round of visiting and meeting Users was conducted, during the User study at B J WADIA hospital, focused at the parents child interaction during:

- Travelling
- Feeding the child
- Playing
- How they manage to put child to sleep

USER 1

CLINIC – Clubfoot clinic at B J WADIA Hospital

CLINICIAN – Dr Alaric Arijoos, Dr Bhushan

LOCATION – Parel

AGE – 1.5 years

CONDITION – Bilateral Clubfoot



USER 2

CLINIC – Clubfoot clinic at B J WADIA Hospital

CLINICIAN – Dr Alaric Arijoos, Dr Bhushan

LOCATION – Parel

AGE – 1.5 years

CONDITION – Bilateral Clubfoot





USER 3

CLINIC – Clubfoot clinic at B J WADIA Hospital

CLINICIAN – Dr Alaric Arijoo, Dr Bhushan

LOCATION – Parel

AGE – 1.5 years

CONDITION – Bilateral Clubfoot





USER 4

CLINIC – Clubfoot clinic at B J WADIA Hospital

CLINICIAN – Dr Alaric Arijoos, Dr Bhushan

LOCATION – Parel

AGE – 2.5 yrs. Old

CONDITION – Bilateral clubfoot



USER 5

CLINIC – Clubfoot clinic at B J WADIA Hospital

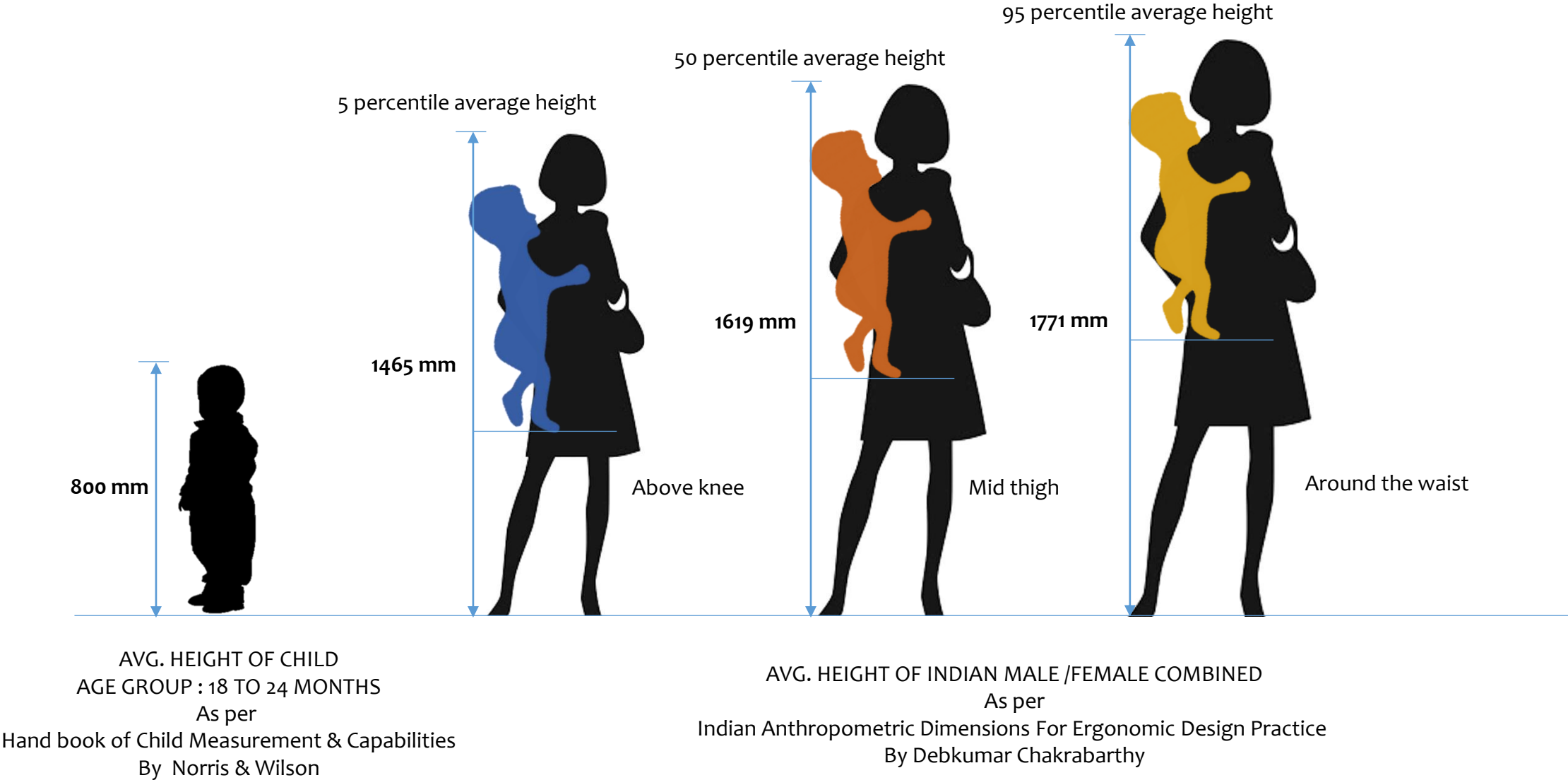
DESIGNATION– Cure NGO Worker

LOCATION – Parel



Anthropometric considerations

POINT OF CONTACT OF BRACE WITH THE BODY



KEY INSIGHTS



A **closed Orthosis**
(shoe) makes it difficult
to know the foot
position within the shoe



Over-lacing
the shoe creates
discomfort to Child &
Parents both



Most Parents
lacks the idea
of how exactly they
followed the given
instruction



Most clinically
popular Orthosis
lacks compliance
with the Users

Ergonomics of Bracing

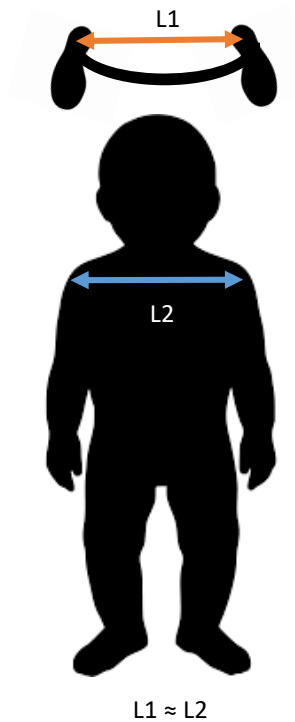


FIG. BRACE LENGTH NORM

Brace size

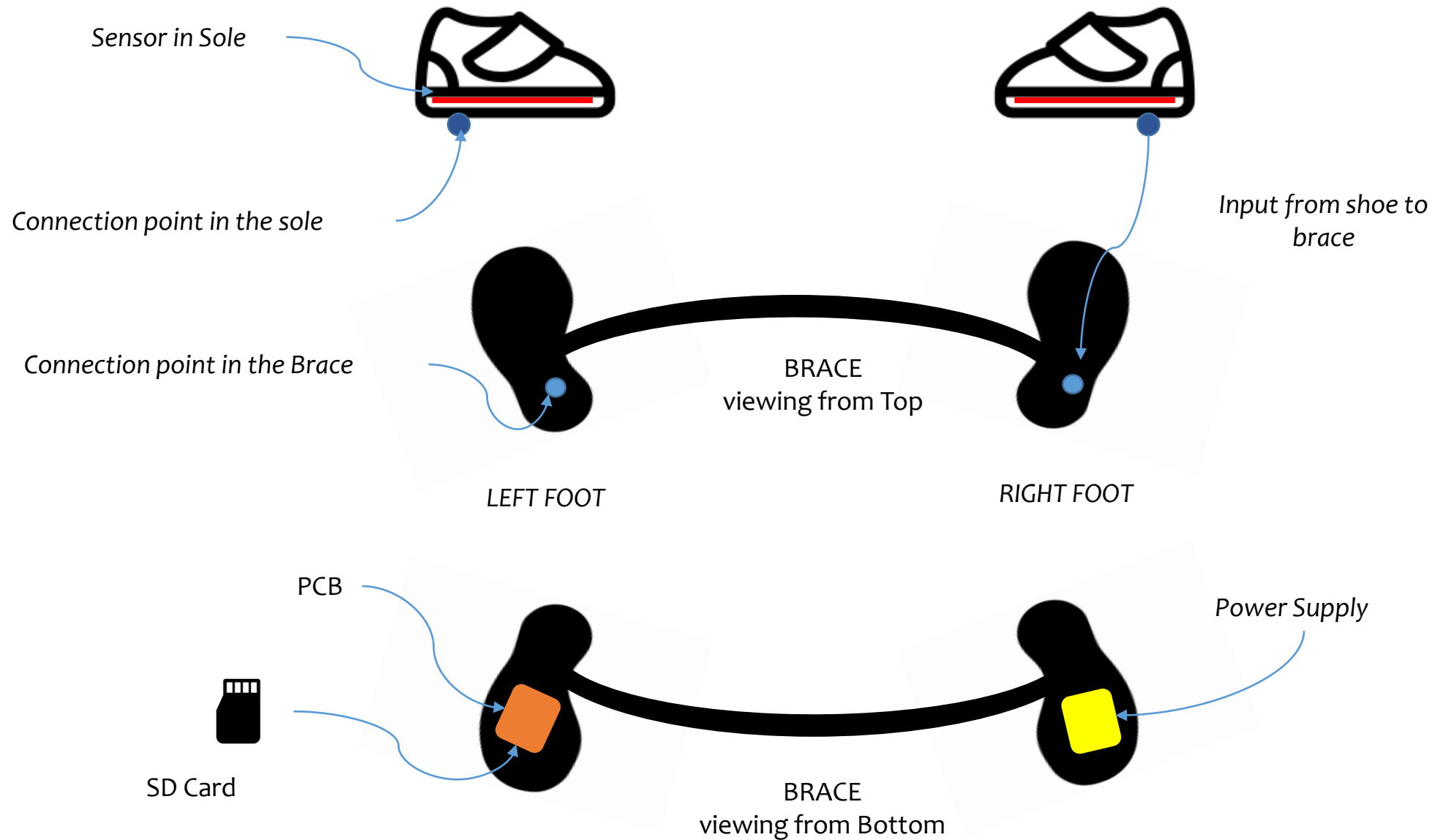
The size of the brace is specified by its distance between the centre of rotation of the feet. This distance should approximately equal the shoulder breadth of the child as specified by the Doctors.

The sizes suggested by the Doctors are:

- **180 mm for age below 2 yrs.**
- **220 mm age above 2 yrs.**

Technology

CIRCUIT SHEMATIC



Proof of Concept

Pressure sensor



Connection points



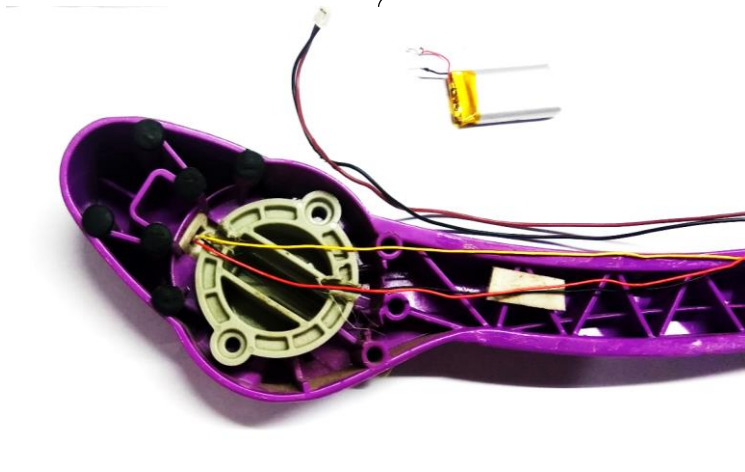
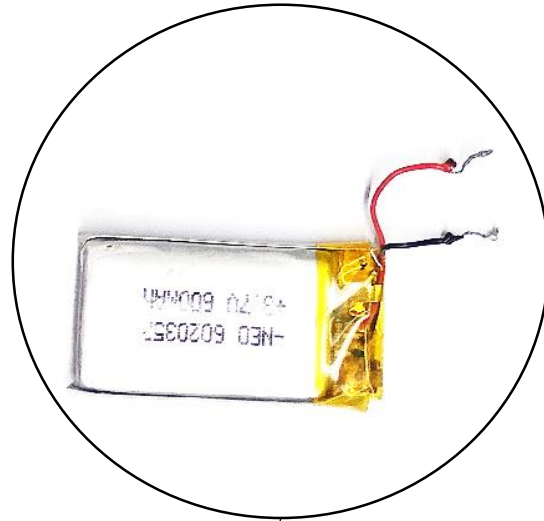
Unmodified brace



Lipo Battery

Dimensions:
35 x 17 x 5mm

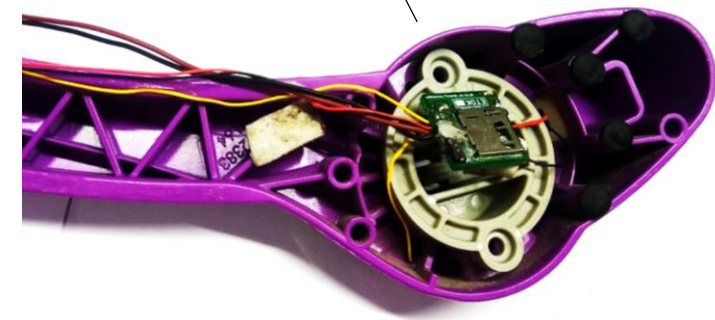
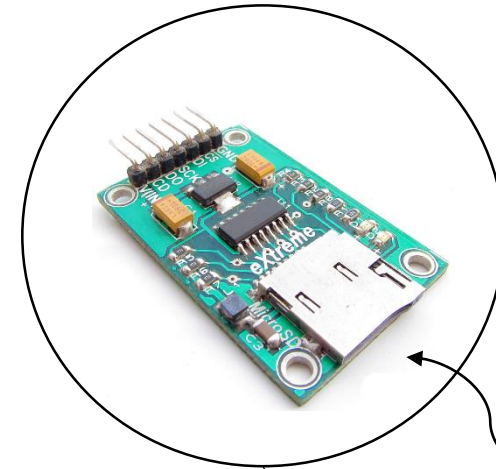
Spécification:
3.7 v 600 mAh



Left End's Bottom View

Micro Data Logger For SD Card

Dimensions:
35 x 35 x 5mm



Right End's Bottom View

Present Procedure [Scenario]



1

When **the child is brought to clinic** and is **allotted with a steinbeek or Stanford brace**.



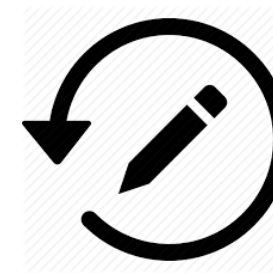
2

In the next visit, **the parents will have to report the conduct of bracing**, prescribed in previous appointment.



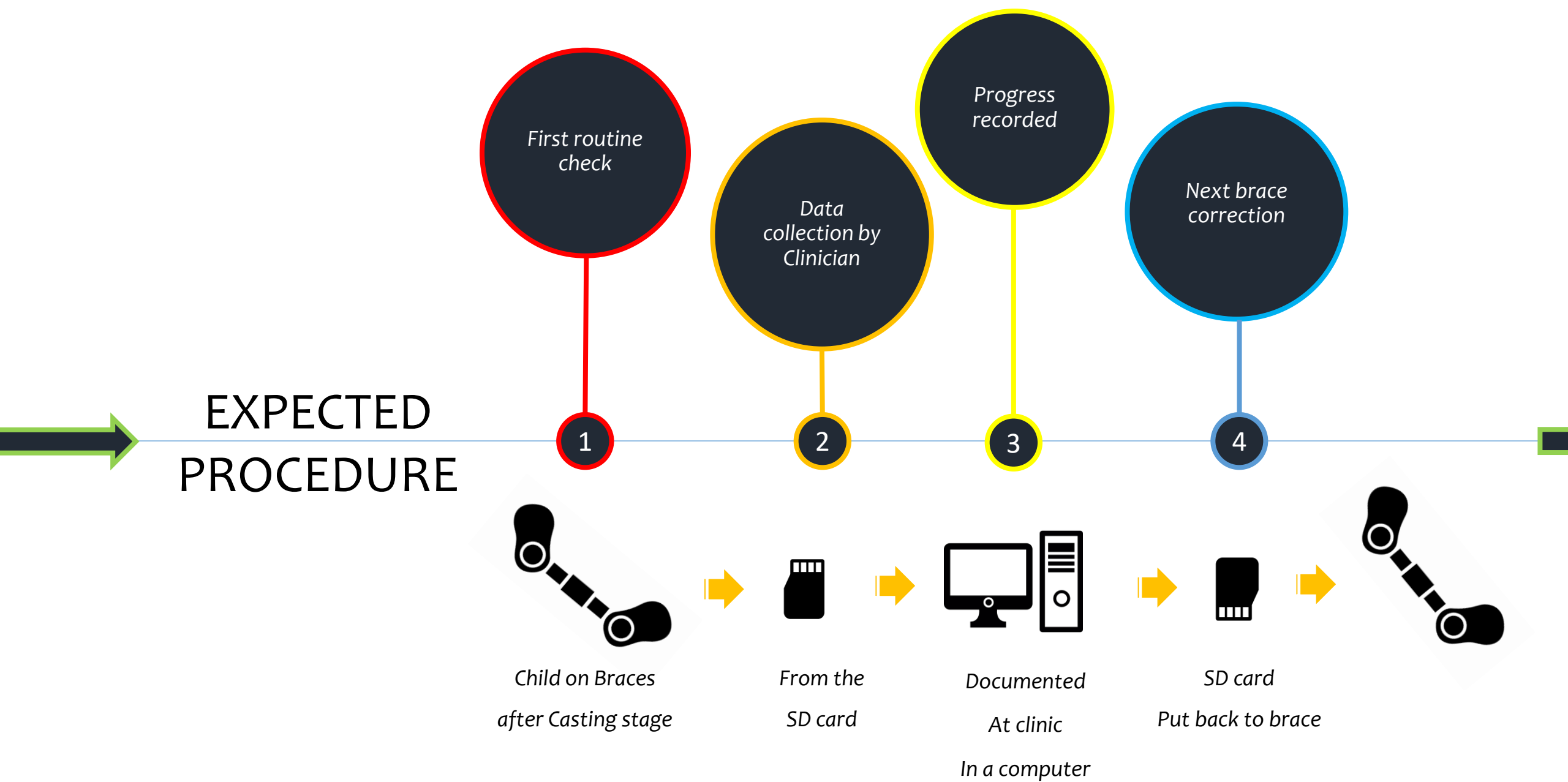
3

Sometimes, **the reporting of follow up by parents is not reliable as per clinicians**, due to which the given treatment can prove to be *false/incorrect*.



4

The child is subjected to **change of size of brace and shoe depending upon the his/her progress**.



BRACING PROTOCOL

The **shoes are put first**

And **then the brace** is put on the shoes

The **step between the angle of abduction** should be **equal to or more than 20 degrees**

and the **angle of dorsiflexion** can maintain between **10° to 15°**.

DESIGN STATEMENT

To design a
Club-foot Abduction Orthosis for
Better User Compliance & True Monitoring of Prescribed Usage

DESIGN BRIEF

FUNCTIONAL REQUIREMENTS

TARGET USER

MAINTAINANCE

USAGE PATTERN

UNOBSTRUSIVE

No electrical circuitry component should be visible

LIGHT IN WEIGHT

Not more than 500 mgs

DATA COLLECTION

Should facilitate realistic data collection

SAFETY

*The orthosis should be
water proof & electrical shock proof*

USER COMFORT

*The orthosis should be easy to adapt
by child & during mother child interaction*

COST EFFECTIVE

The cost should not be more than \$ 25

DESIGN BRIEF

FUNCTIONAL REQUIREMENTS

TARGET USER

MAINTAINANCE

USAGE PATTERN

PRIMARY USER
Child

SECONDARY USER
Parents/ Guardian

TERTIARY USER
Clinicians and NGO staff

DESIGN BRIEF

FUNCTIONAL REQUIREMENTS

TARGET USER

MAINTAINANCE

USAGE PATTERN

BATTERY REPLACEMENT

Every 3 months

By clinicians

EASE OF CLEANING

*the orthosis should be easy to clean
of particulate and fluid dirt*

DESIGN BRIEF

FUNCTIONAL REQUIREMENTS

TARGET USER

MAINTAINANCE

USAGE PATTERN

INITIALLY

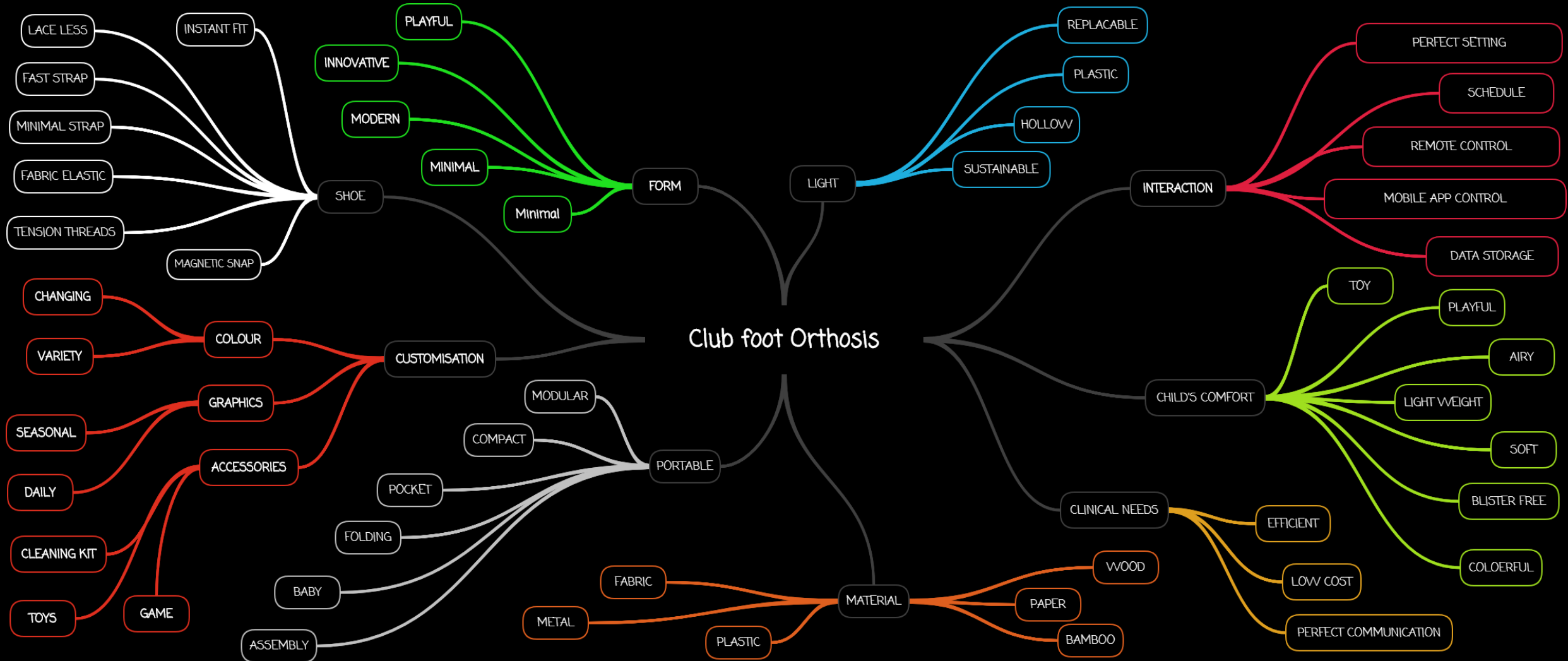
*Braces to be used 23 hrs. a day
(for first 4 months)*

REGULAR

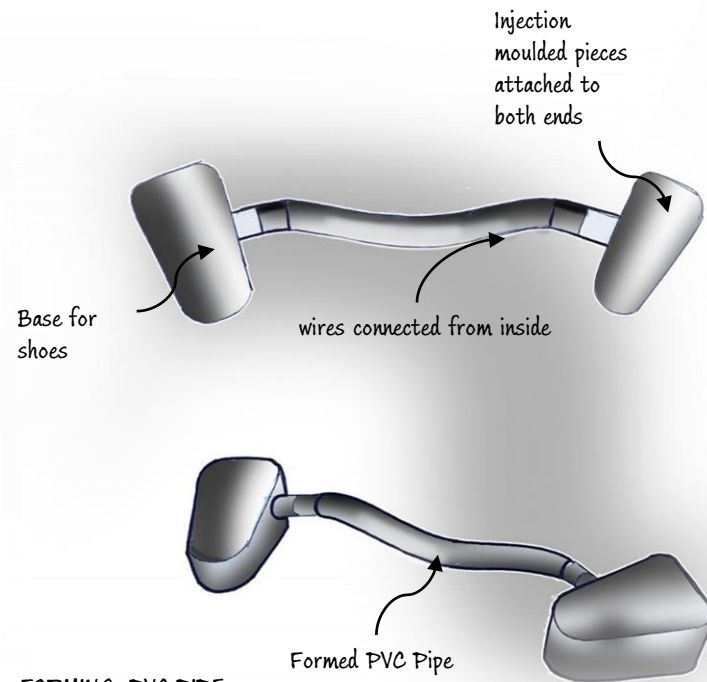
*Then 12 hrs. a day
(for next 3-4years)*

Ideations For Brace

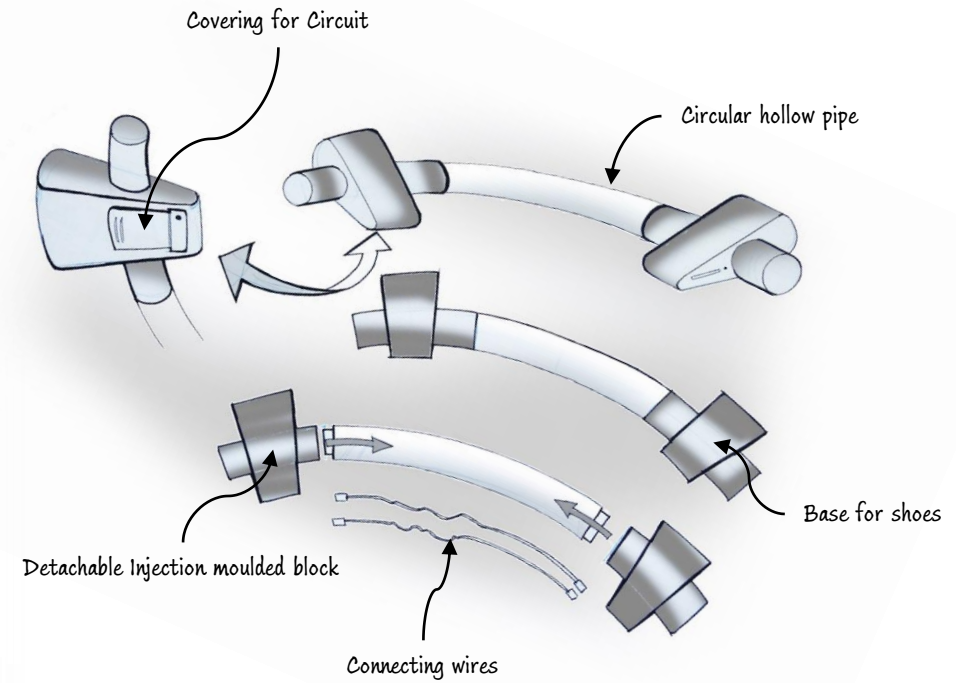
MIND MAPPING



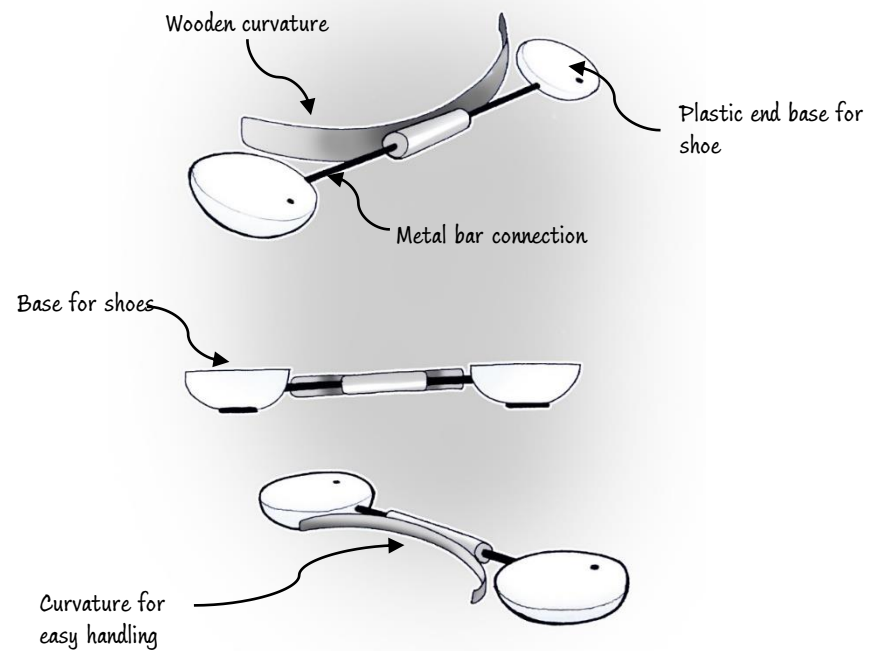
GROUP 1- FRUGAL MANUFACTURING



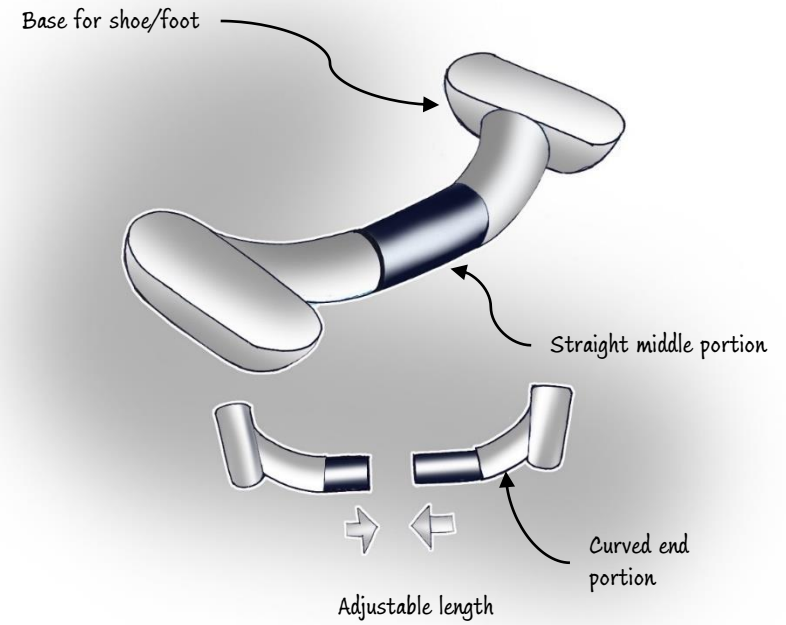
KEYWORDS : FORMING, PVC PIPE



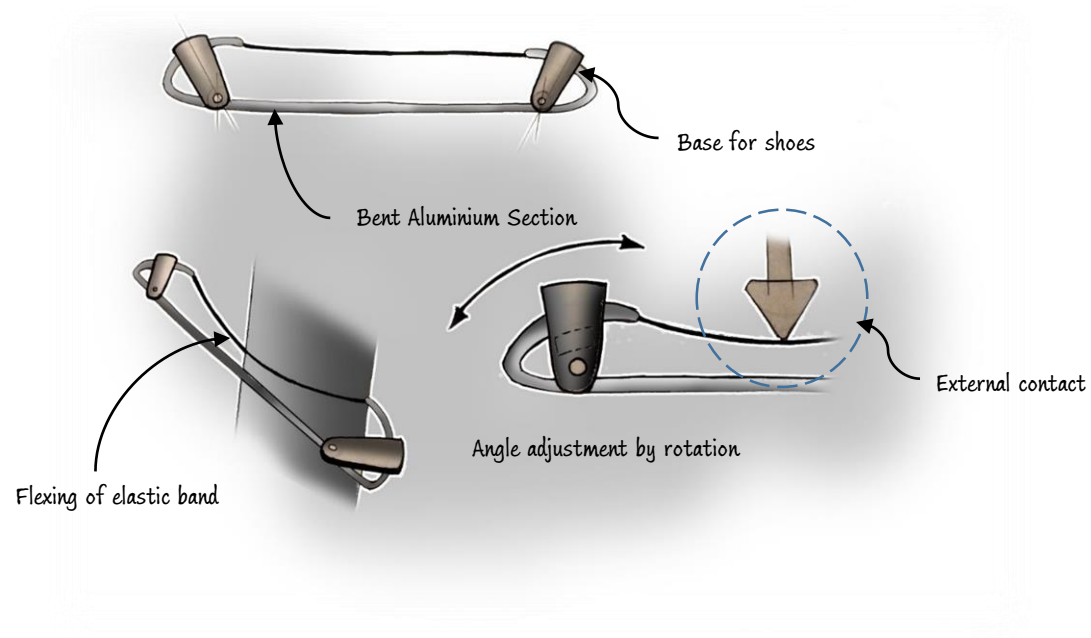
KEYWORDS :
FORMING, PVC PIPE, DETACHMENT



KEYWORDS : SUSTAINABLE, ABUNDANCE, MATERIALS

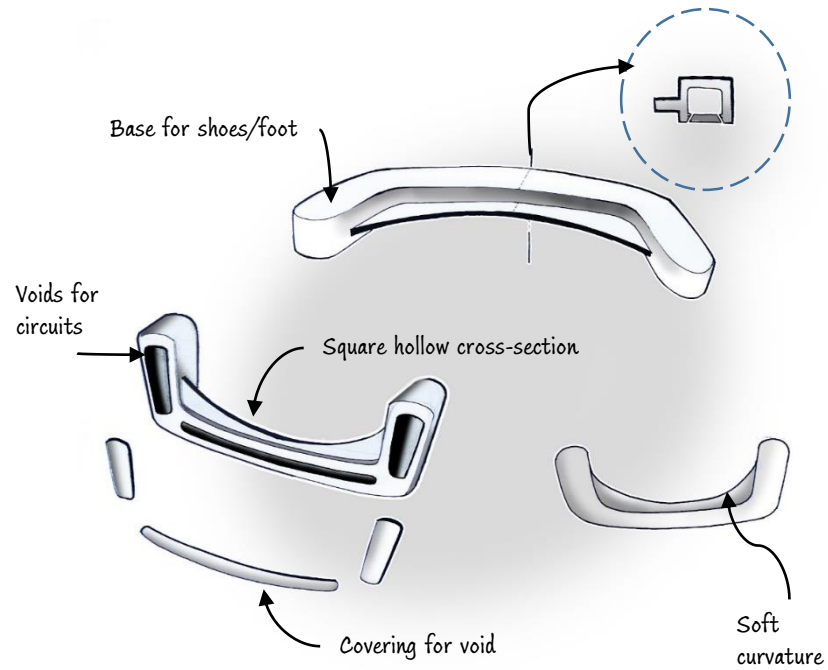


KEYWORDS : LENGTH ADJUSTMENT

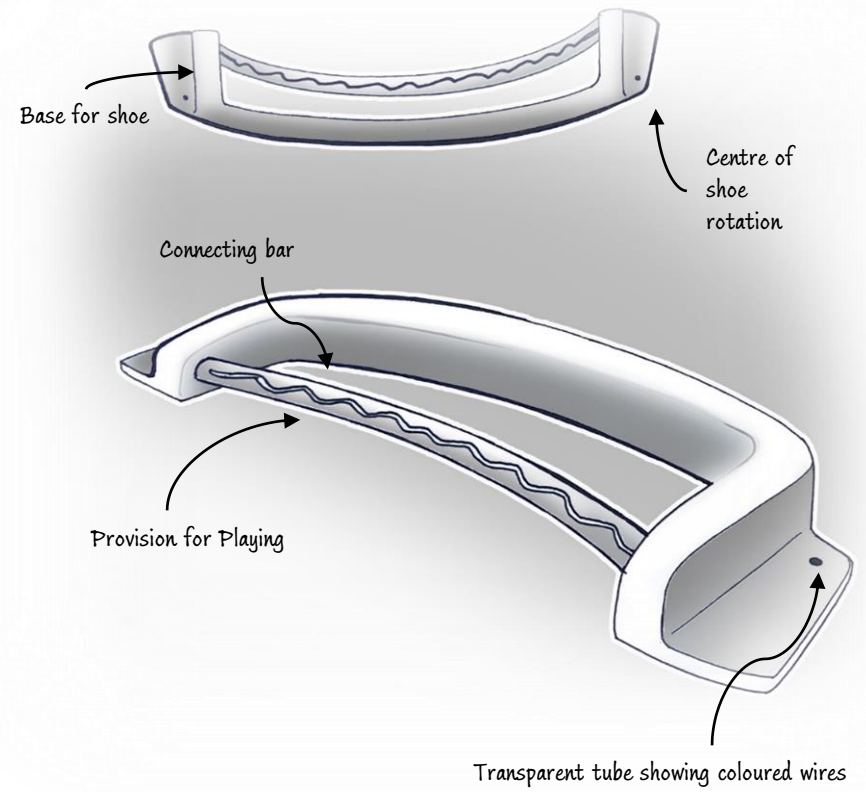


KEYWORDS :
EXTRUSION, BENDING, LIGHT, STRONG

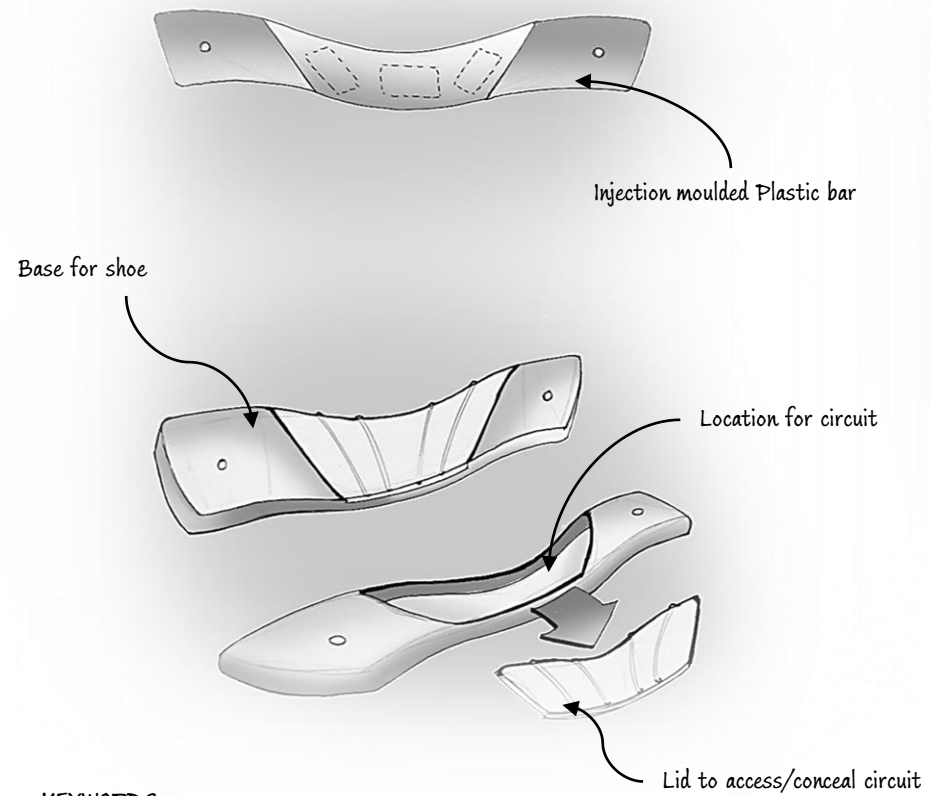
GROUP 2- INTEGRAL BODY



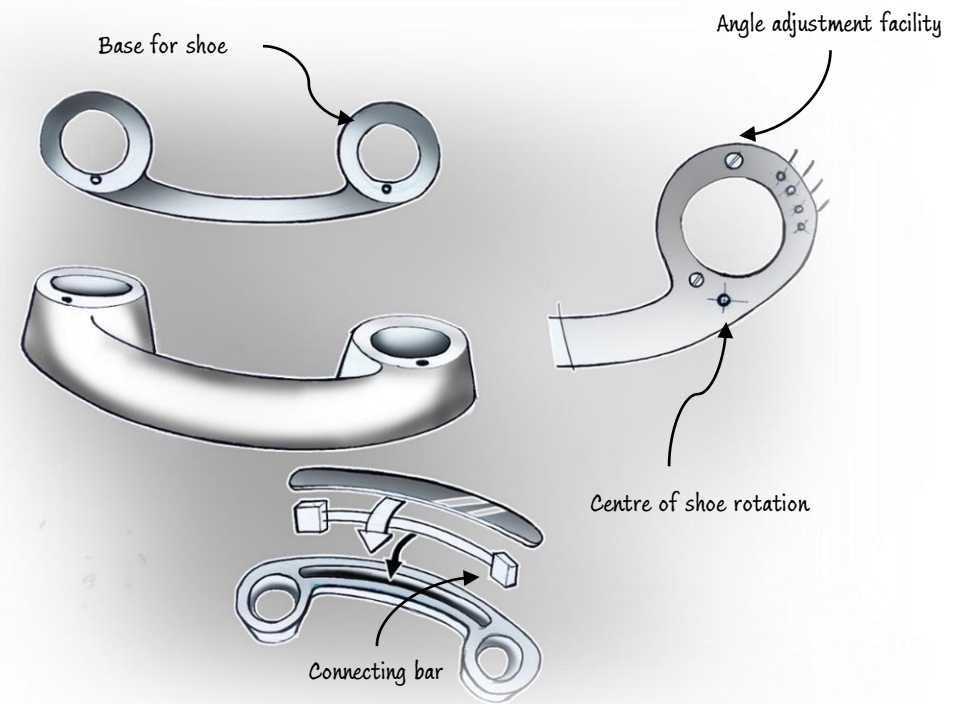
KEYWORDS : RIGID, UNIBODY



KEYWORDS :
SURPRISE, TRANSPERANT, COIL, PEDAL

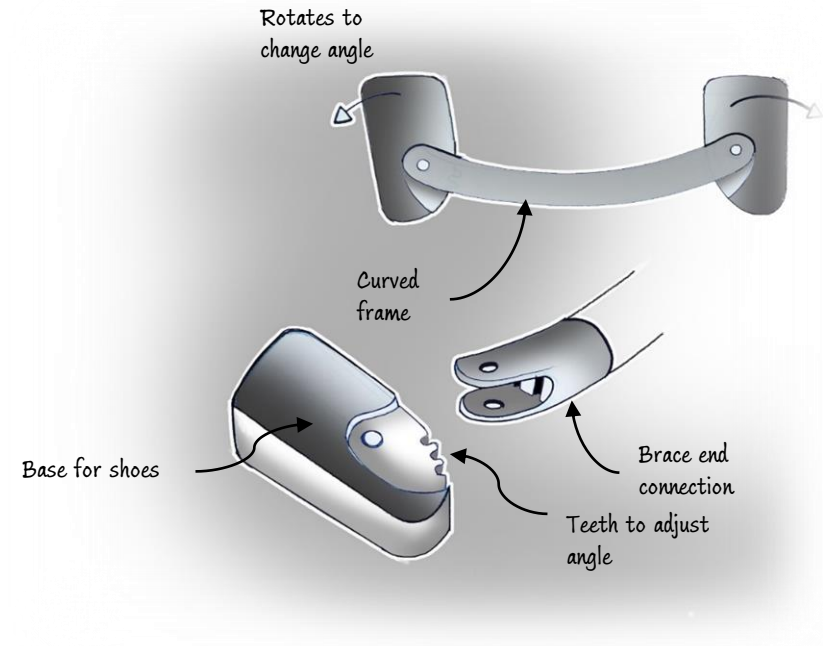
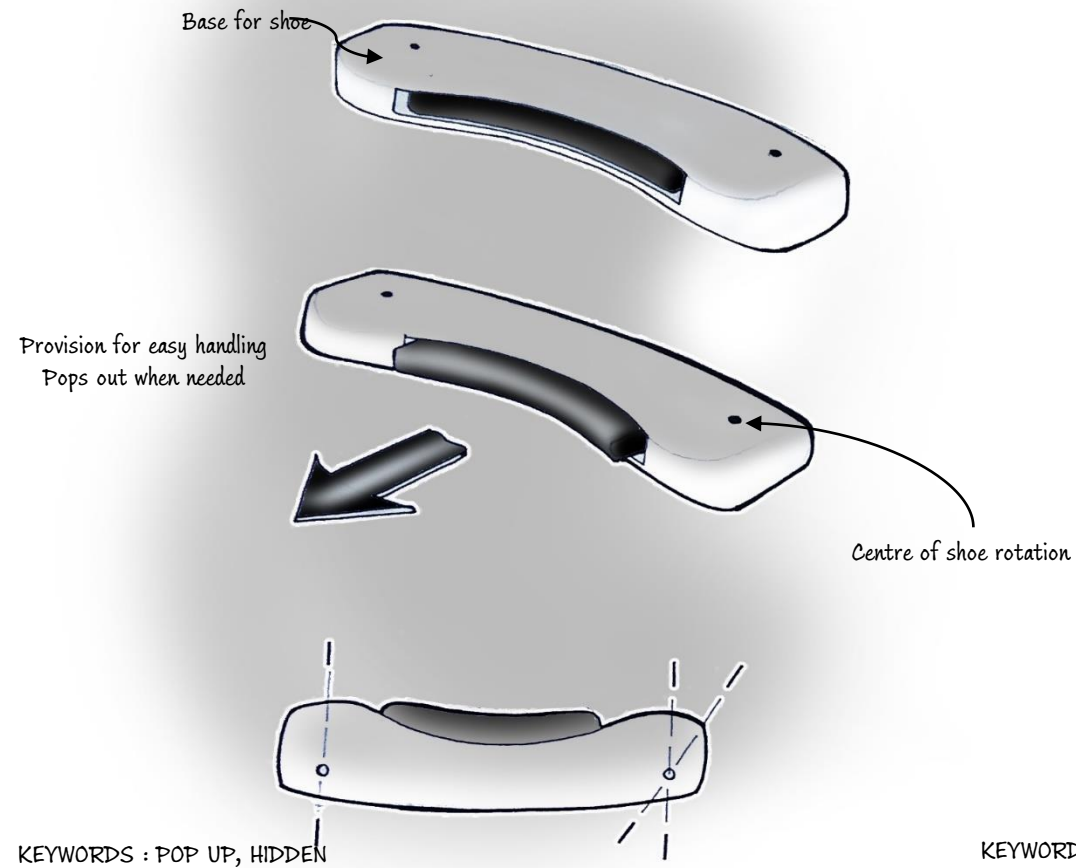


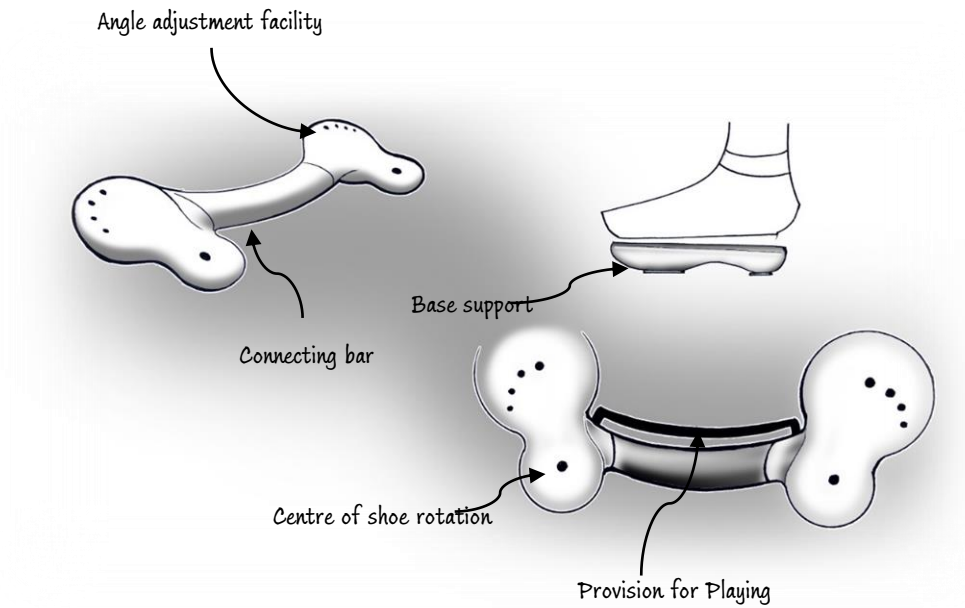
KEYWORDS :
UNIBODY, COMPACT SOFT, CLARITY



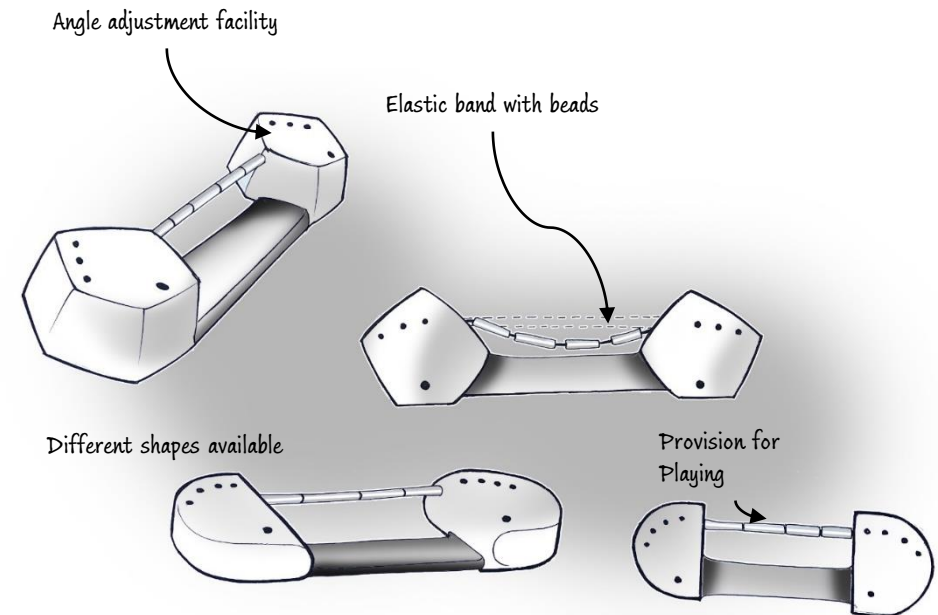
KEYWORDS :
HOLLOW, SOFT, TELEPHONE

GROUP 3- ADDED FUNCTIONALITY





KEYWORDS : BONE, CONNECTION, STRENGTH, LINK



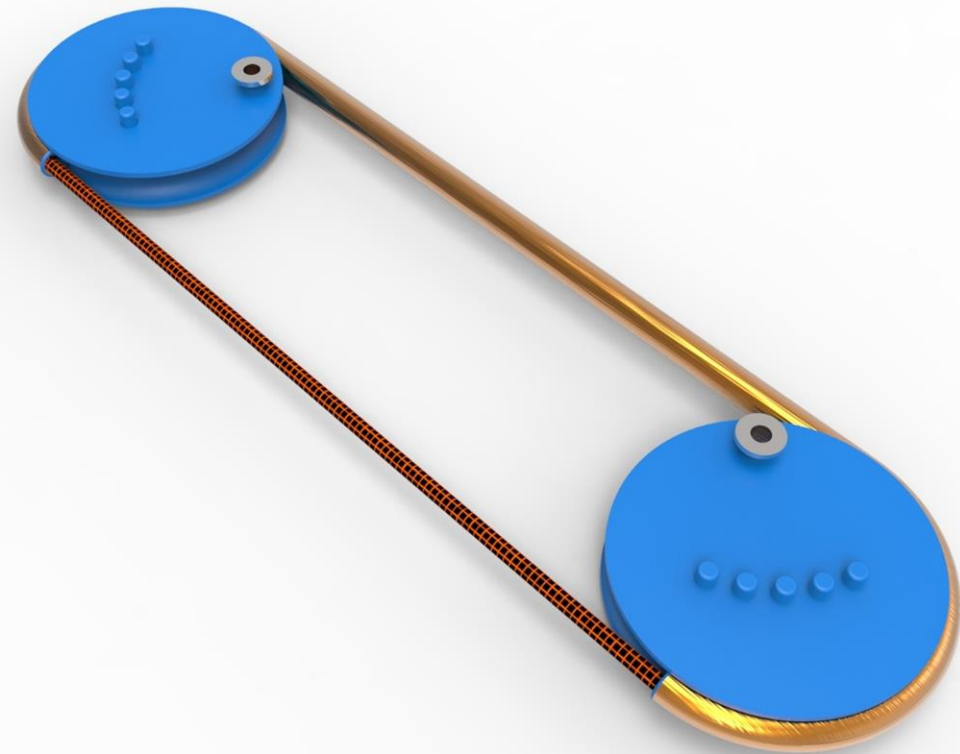
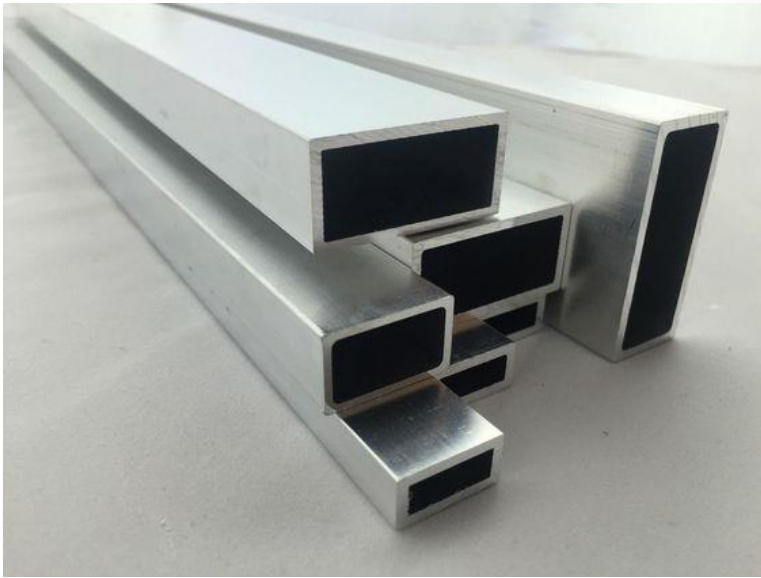
KEYWORDS : PLAY, SHAPE, ATTRACTIVE

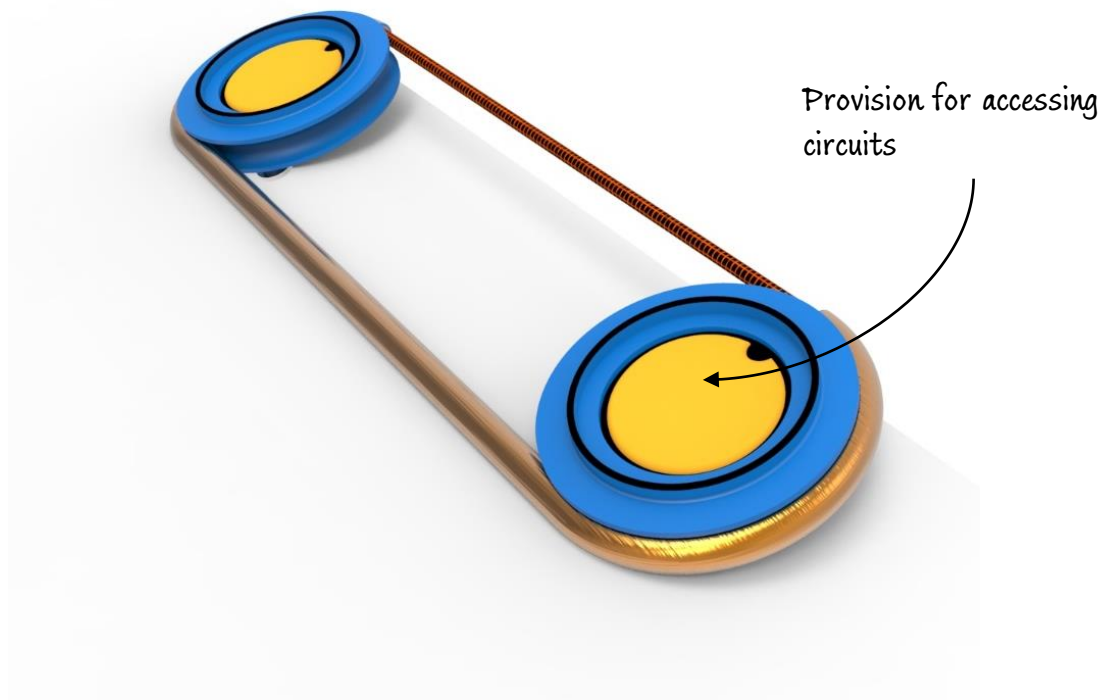
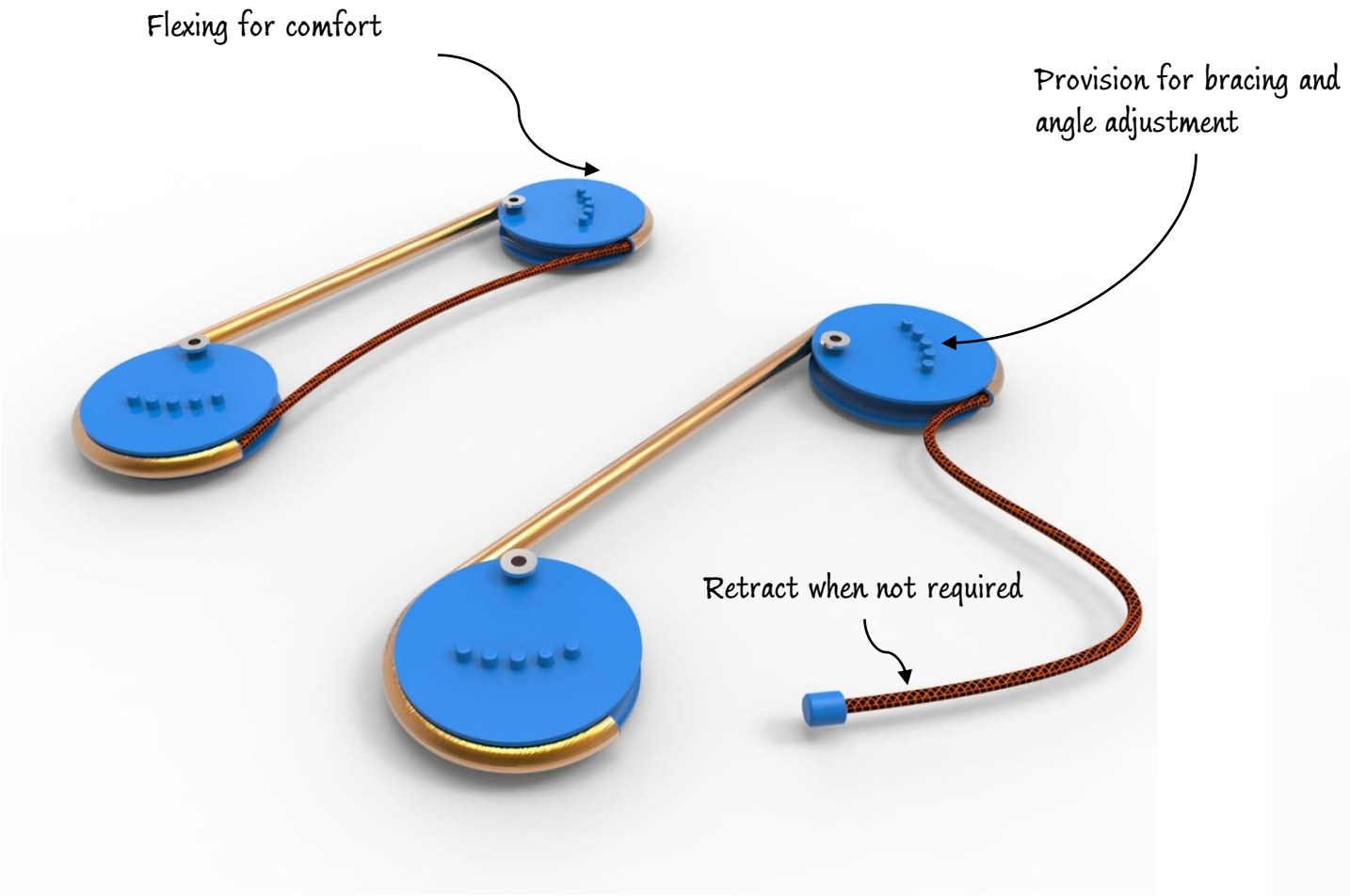
Concepts For Brace

CONCEPT 1

Inspiration

An Aluminium sections



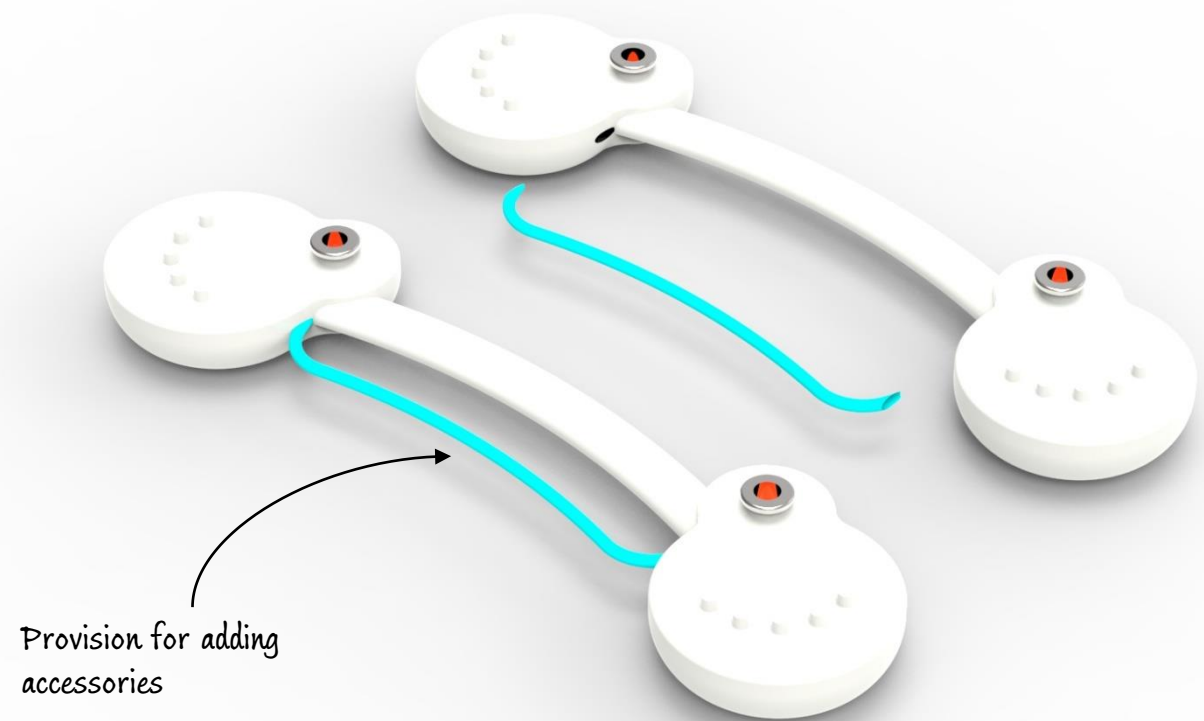


CONCEPT 2

Inspiration

A Bone

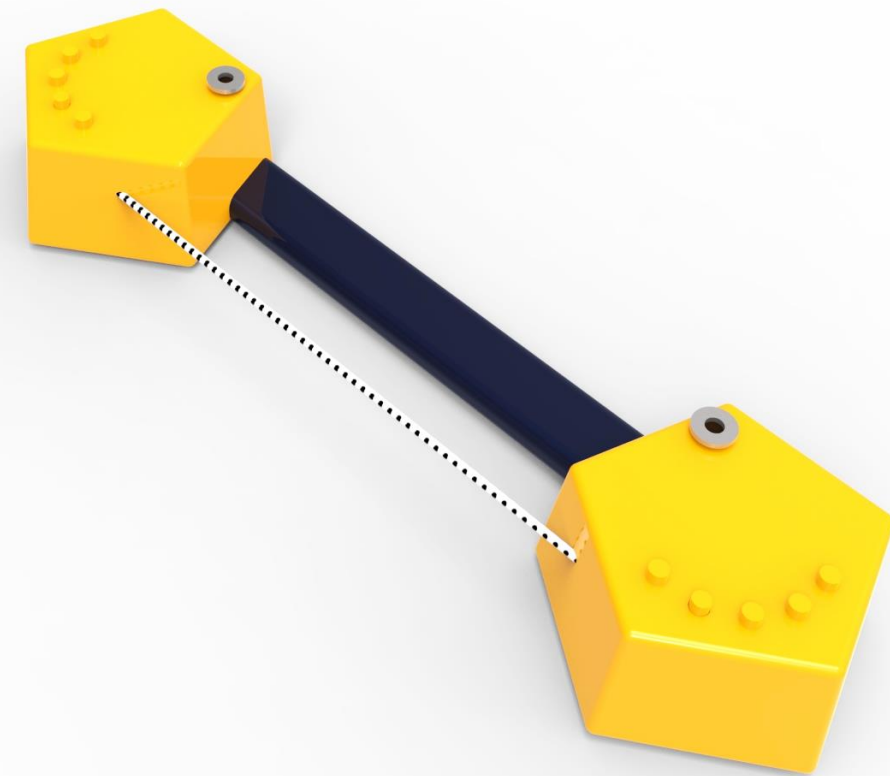




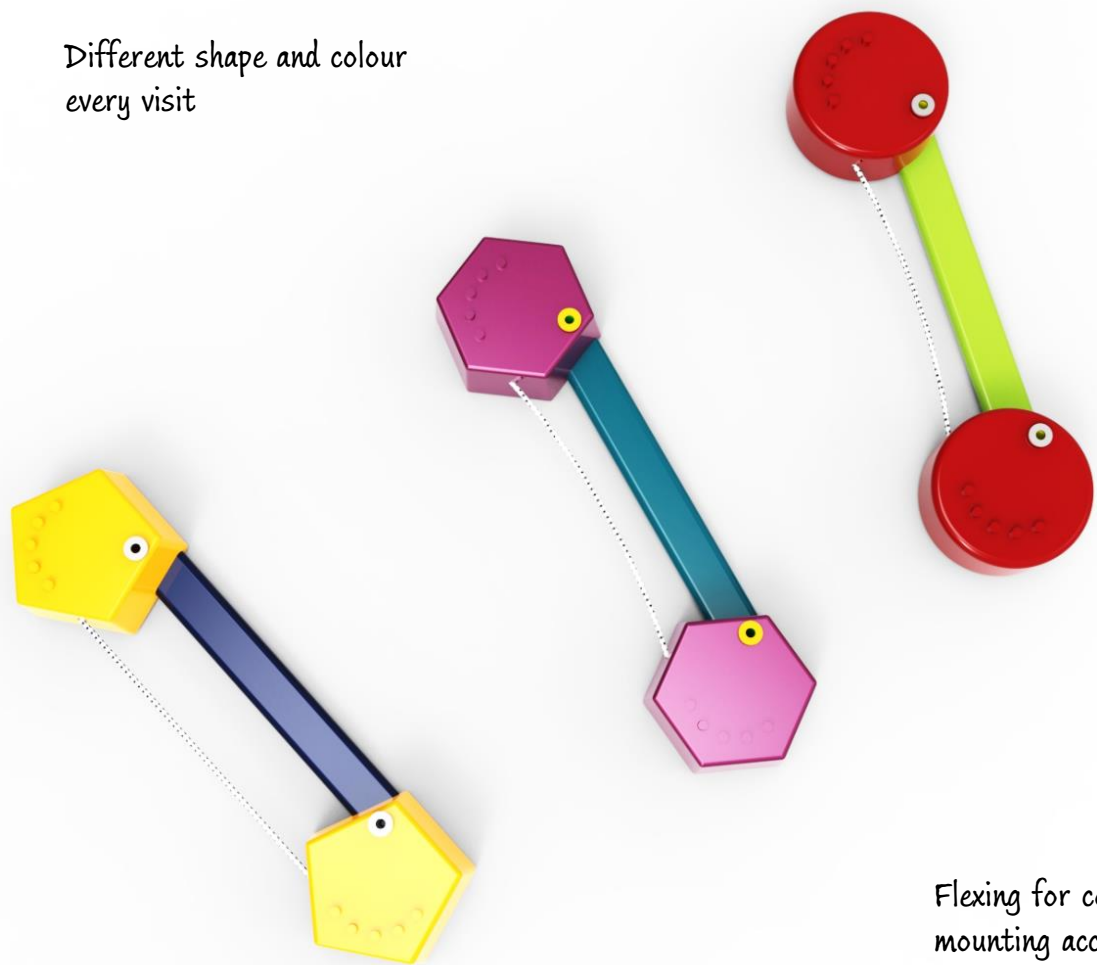
Provision for adding
accessories

CONCEPT 3

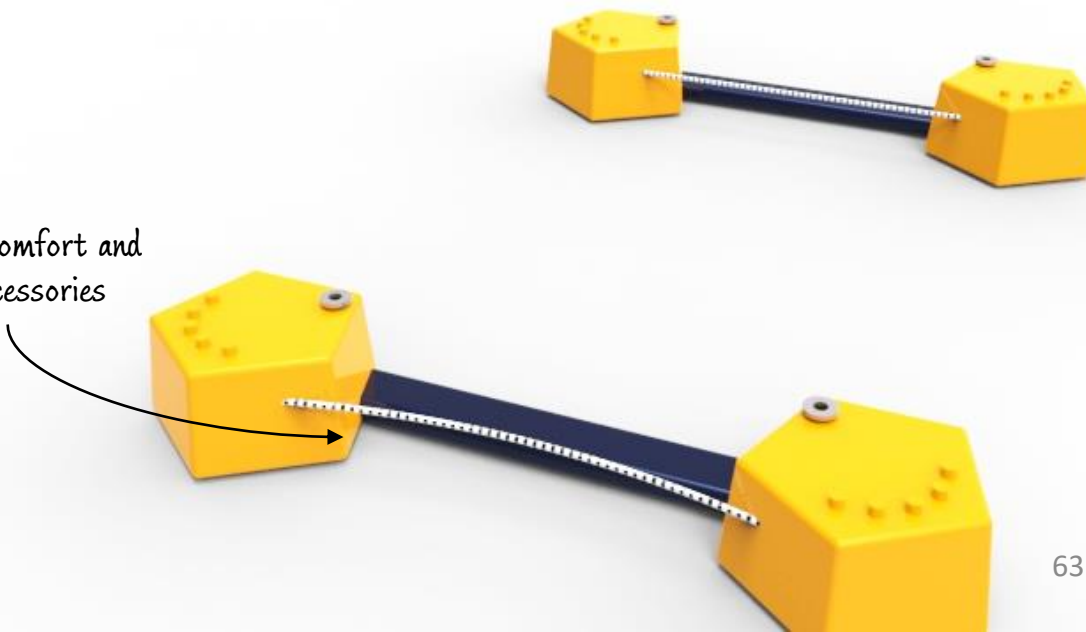
Inspiration
The Lego block



Different shape and colour every visit



Flexing for comfort and mounting accessories



CONCEPT 4

Inspiration

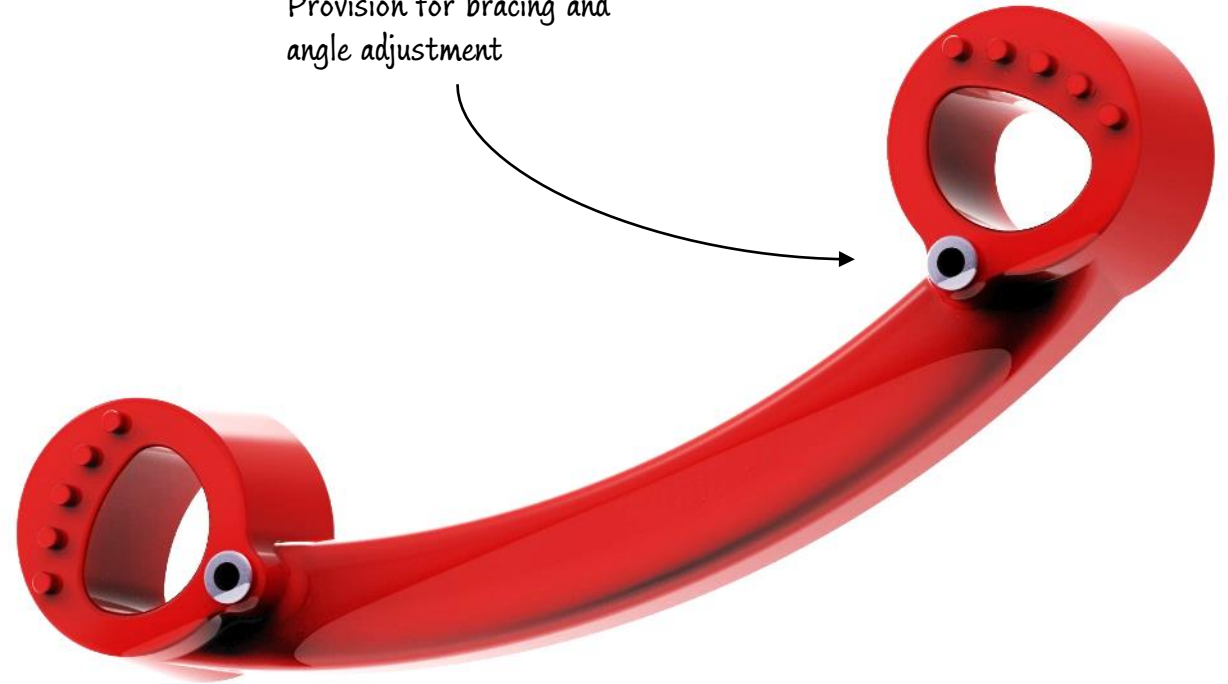
The Telephone toy





Hollow structure to add strength

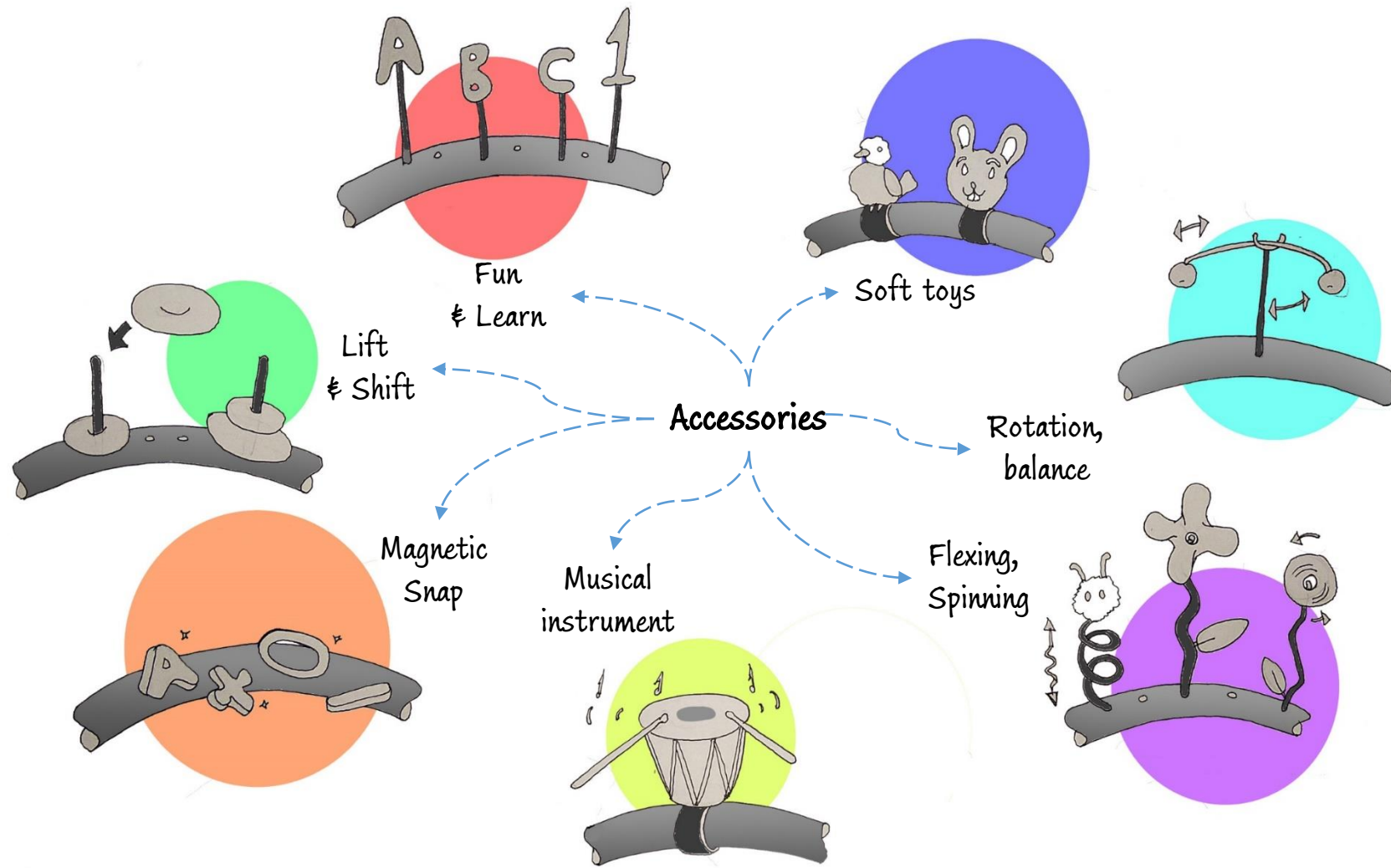
Provision for bracing and angle adjustment

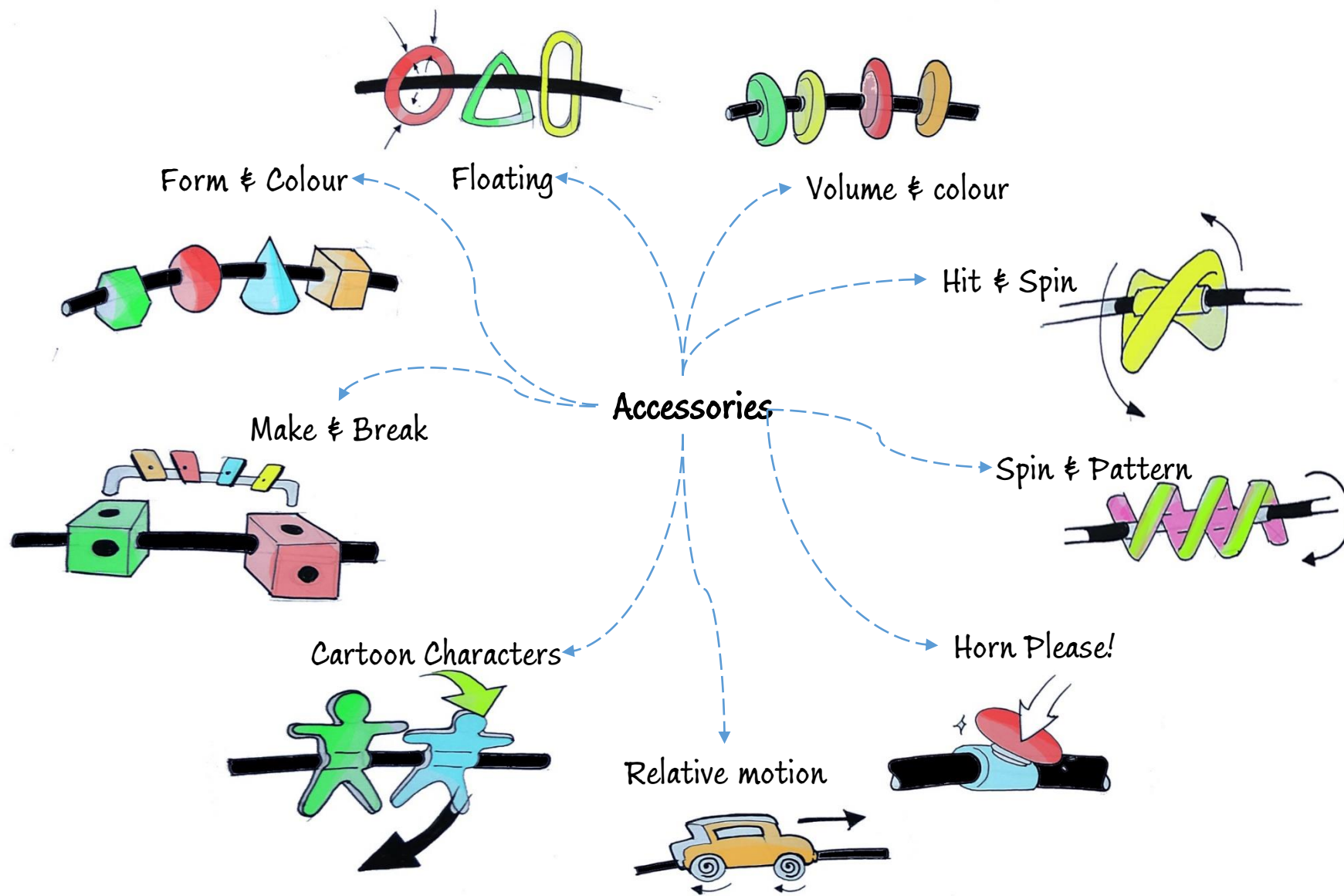


Ideations For Accessories



Bracing becomes burden!





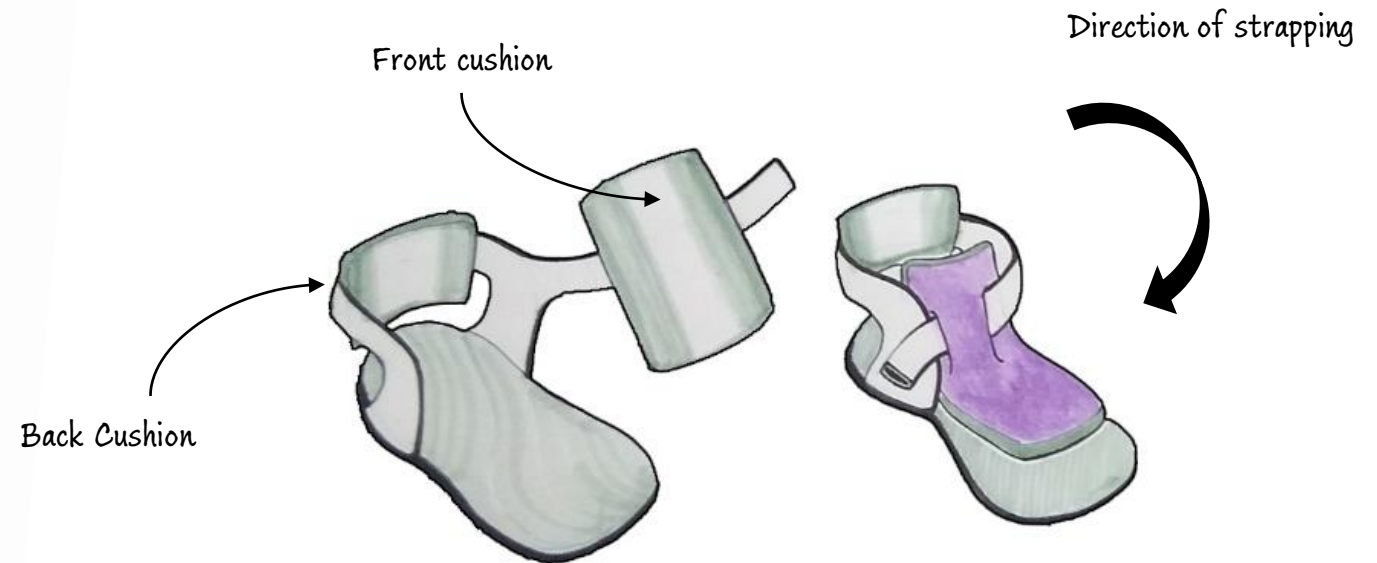
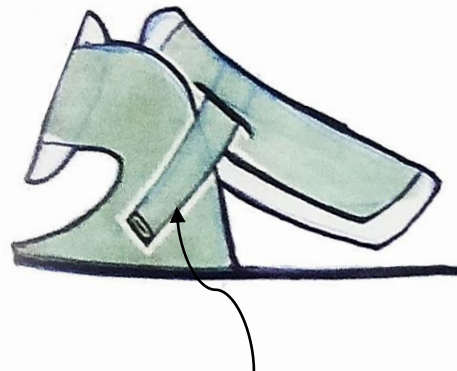
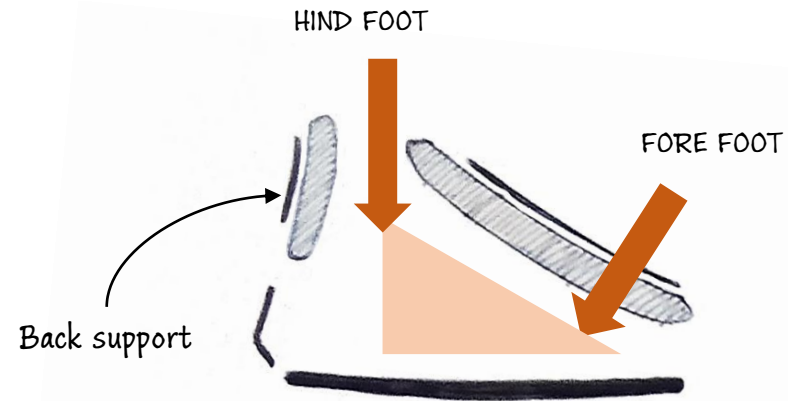
Locating the Foot

Required fastening for foot

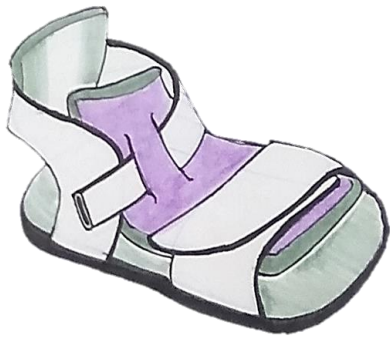


FIG. FOOT DIVISION

<http://lfaclinic.co.uk/wp-content/uploads/2014/11/Slide12-300x179.jpg>



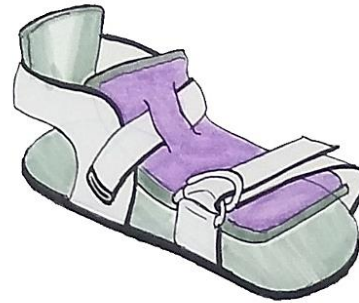
Ways to Strap



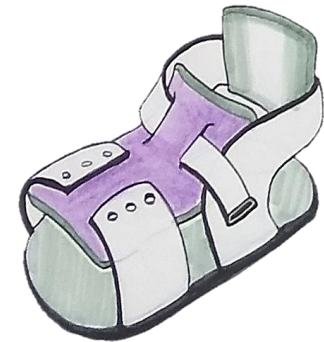
Velcro



Combination of
Elastics, button
& Velcro



Combination of
Buckle with
Velcro



Lace



Making of mock-up Model
For a reference

Constructing straps around
the Model



Static anthropometry data for Leg & Foot

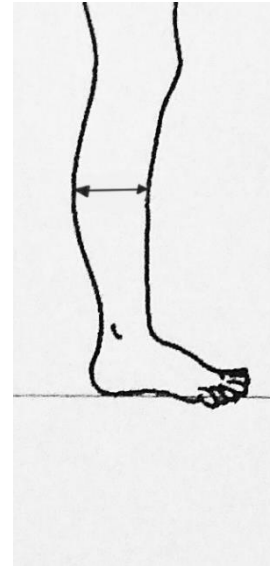
AGE GROUP 3 TO 4 YEARS

As per

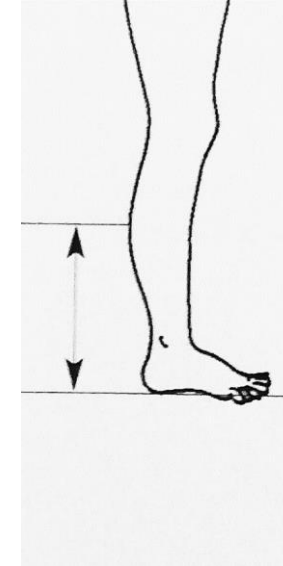
SECTION 1.5

Hand book of Child Measurement & Capabilities

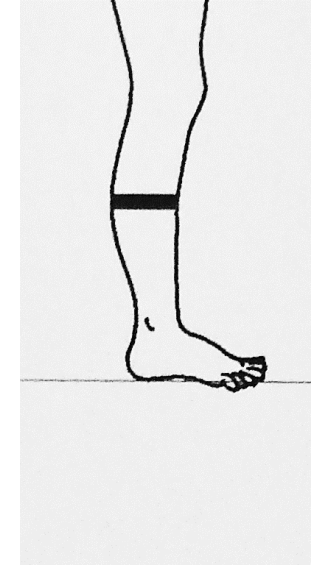
By Norris & Wilson



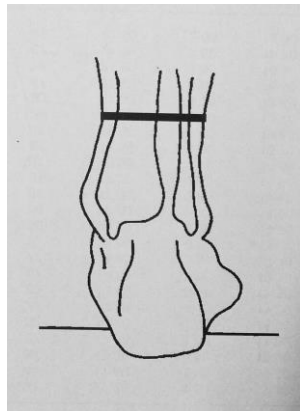
Calf Depth
6.5 cm



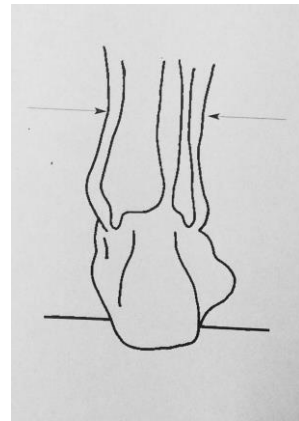
Calf height
18.6 cm



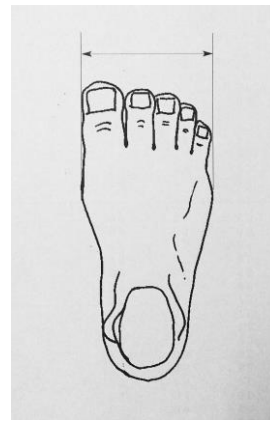
Calf circumference
20.6 cm



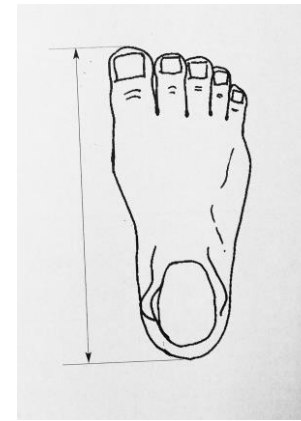
Ankle circumference
15.4 cm



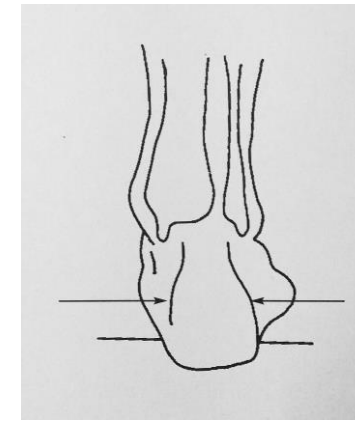
Ankle breadth
3.8 cm



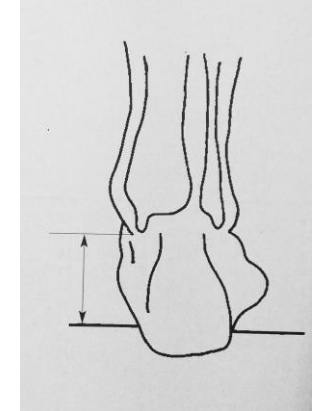
Foot breadth
6.8 cm



Foot length
15.5 cm



Heel breadth
4.6 cm



Ankle height
3.9 cm

Feedback by Parents

- Strapping with **only Velcro** was preferred by all parents
- **Visual accessibility** of foot and **Inspection** is easier
- with present way of strapping & flat sole
- **Wider front strap** would be better

Mock Up and Iterations

TRIAL 1



TRIAL 2



TRIAL 3



TRIAL 4



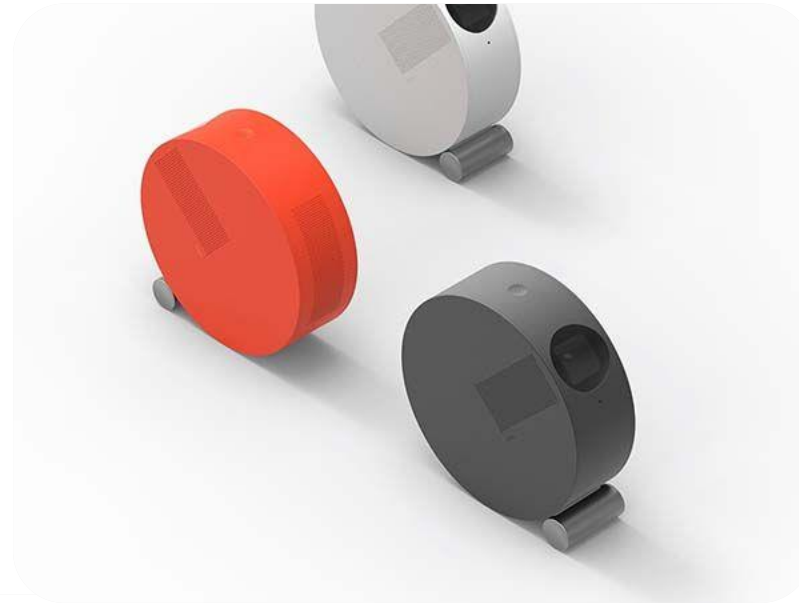
Feedback from Doctors

- To keep the **edge on the internal side straight** with a wall
- **Increase the span of cushion** from behind the heel

Concept Evaluation for Brace

Criteria	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
LIGHT WEIGHT	4	1	2	3
CUSTOMISATION	2	3	1	4
SAFETY	3	1	2	4
FORM FACTOR	4	1	3	2
EASE OF CLEANING	4	1	2	3
Average rank	3.4	1.4	2	3.2

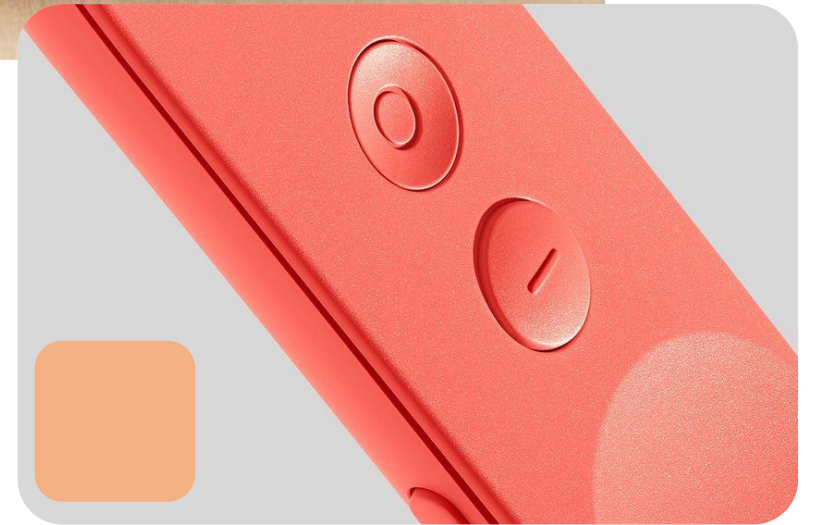
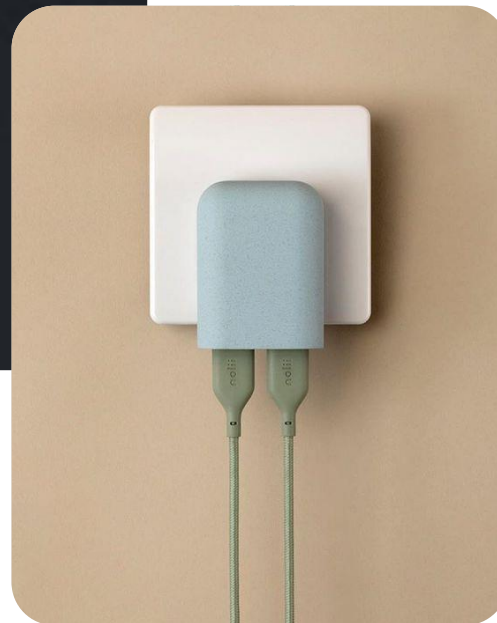
Mood board 1
PLAYFUL



Mood board 2

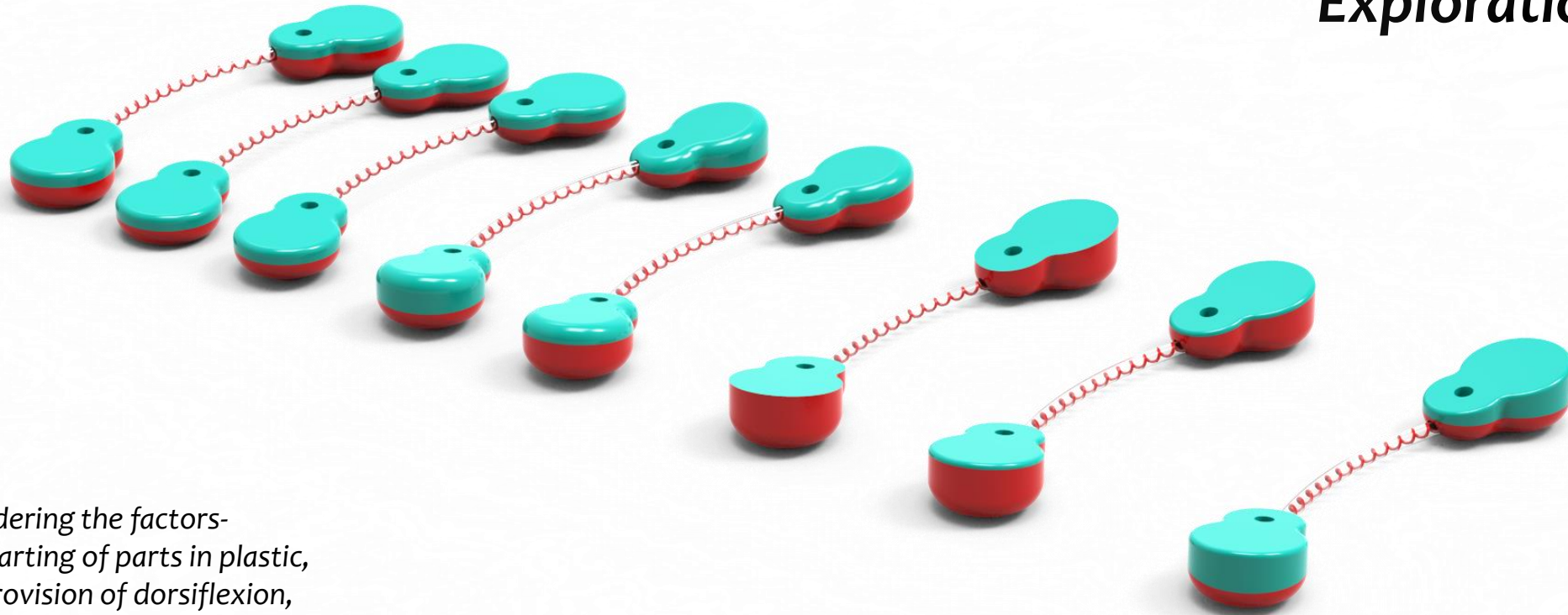
SOFT





Mood board 3
MINIMAL

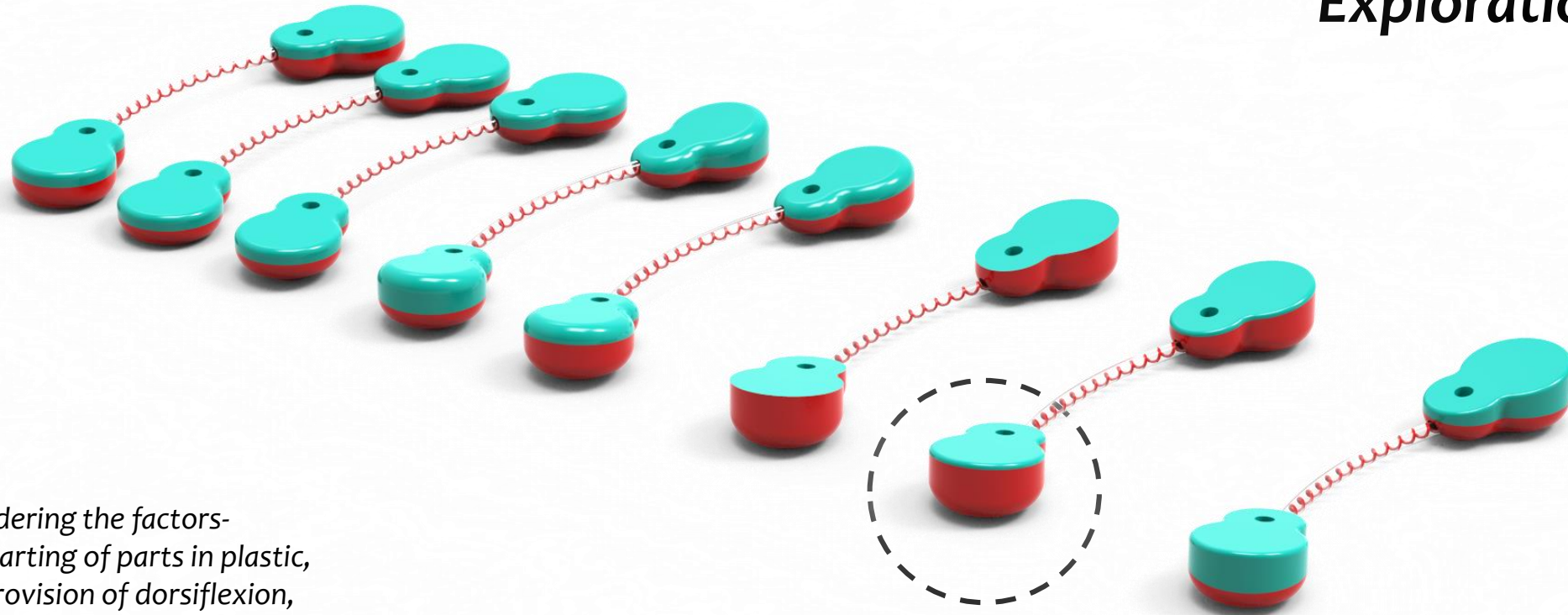
Formal Exploration



Considering the factors-

- parting of parts in plastic,
- provision of dorsiflexion,
- structural integrity,
- height of partition above the ground
- and expression from mood Boards some variations were done.

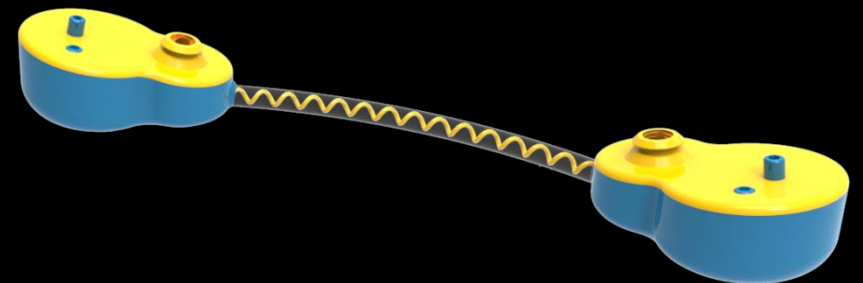
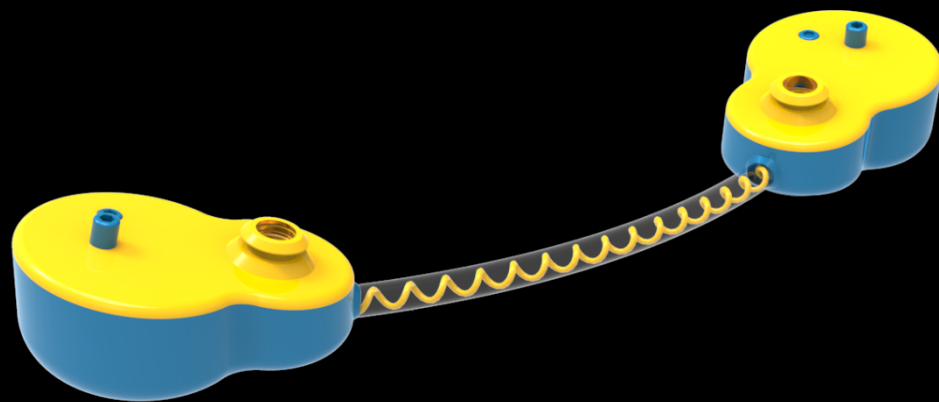
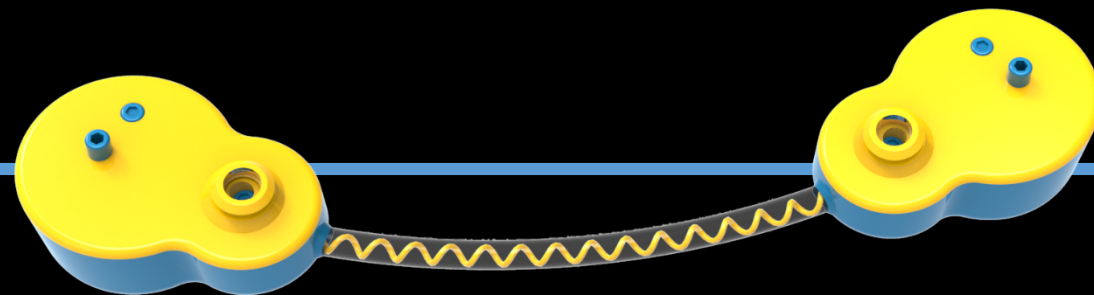
Formal Exploration



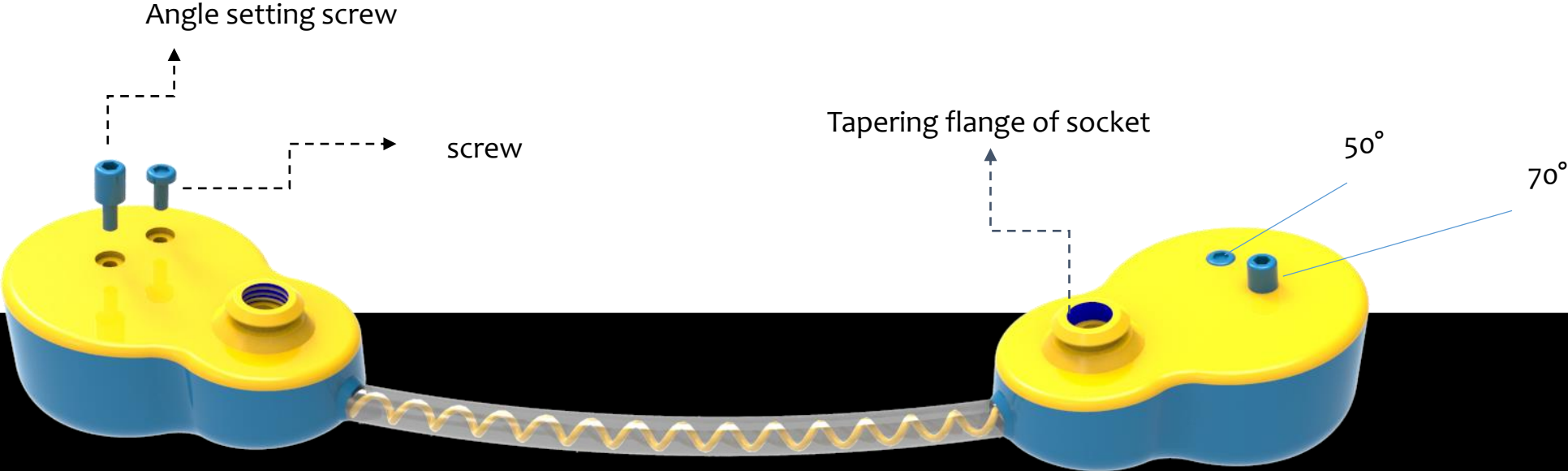
Considering the factors-

- parting of parts in plastic,
- provision of dorsiflexion,
- structural integrity,
- height of partition above the ground
- and expression from mood Boards some variations were done.

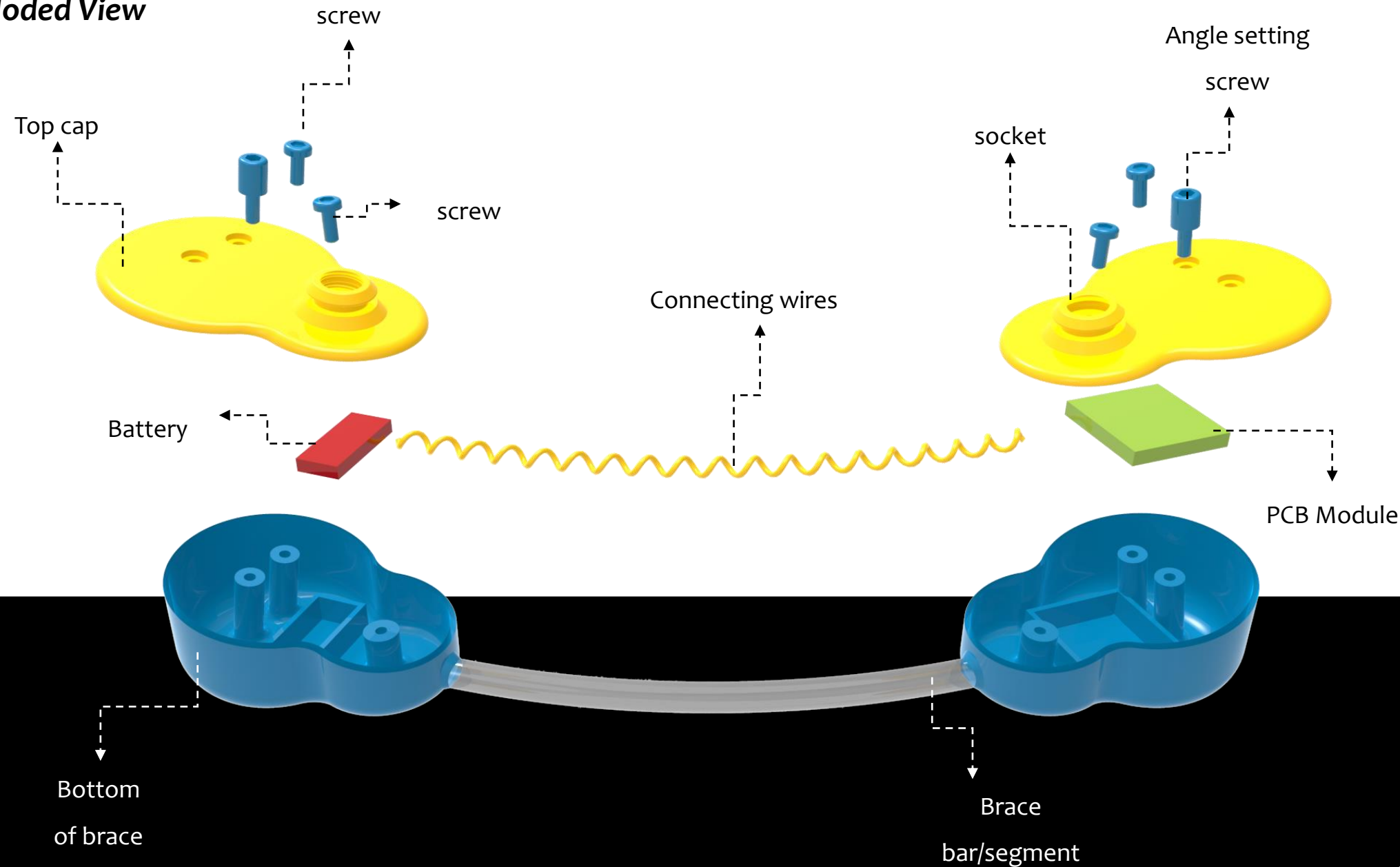
The Brace



Angle adjustment

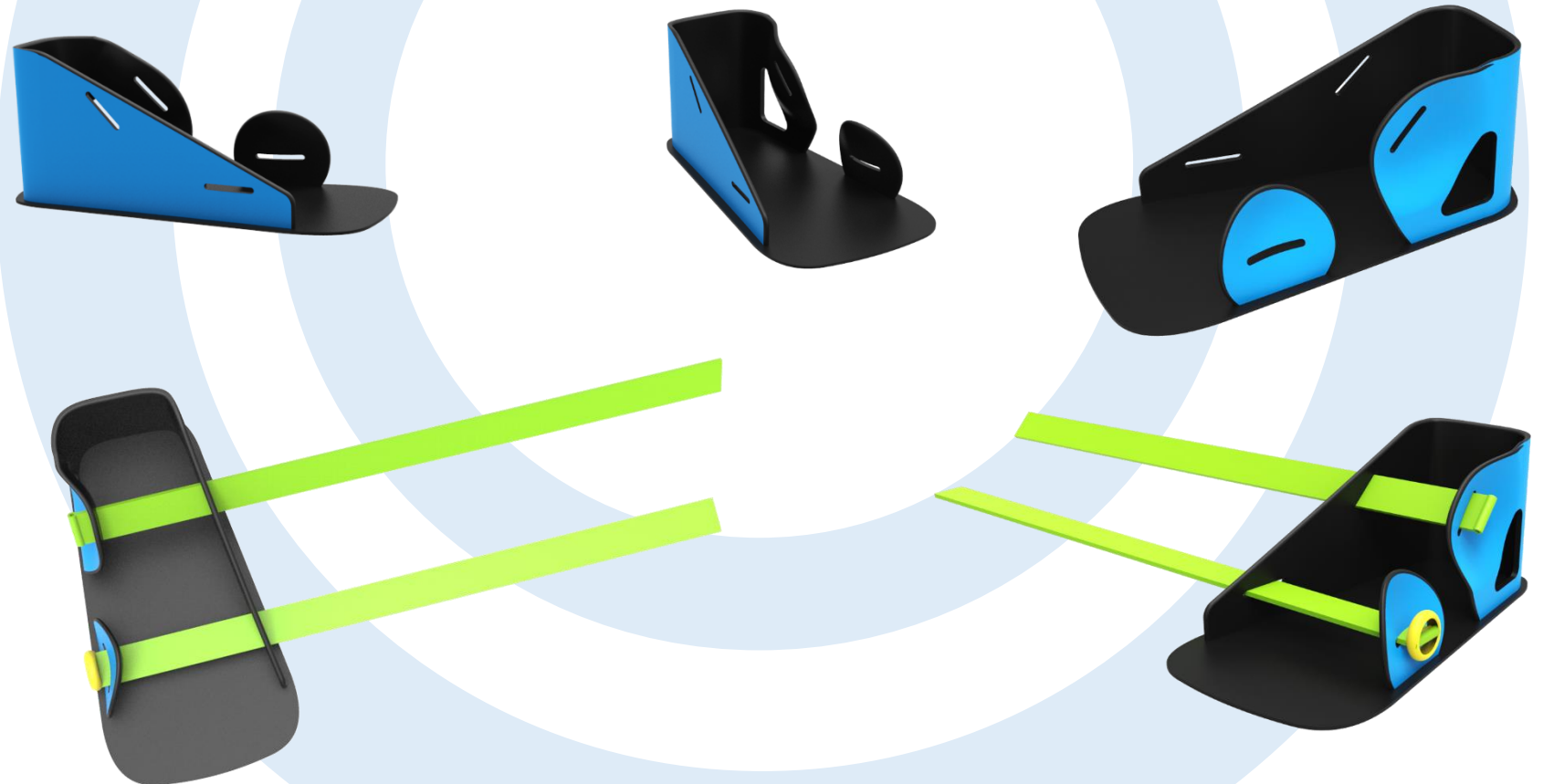


The Exploded View

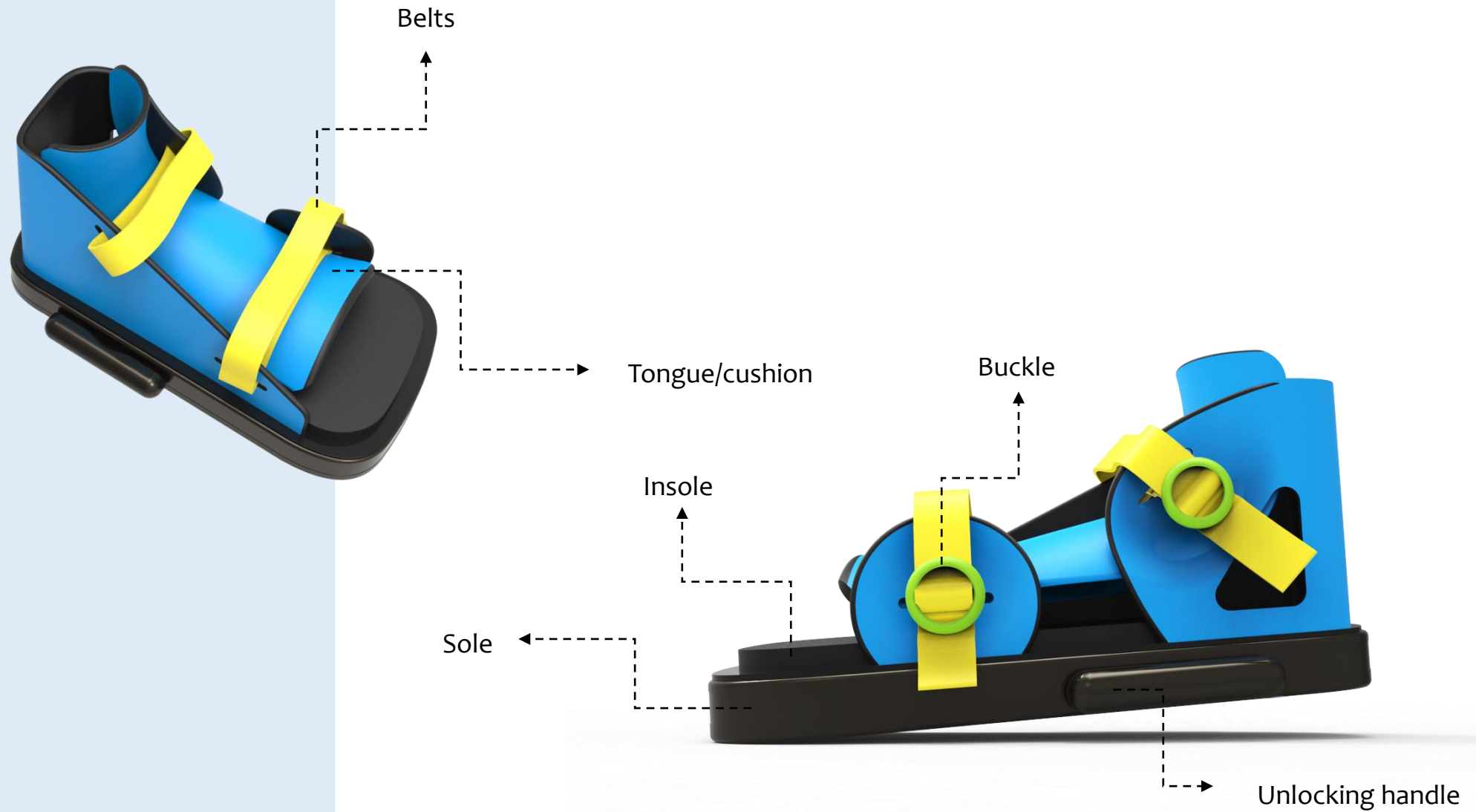


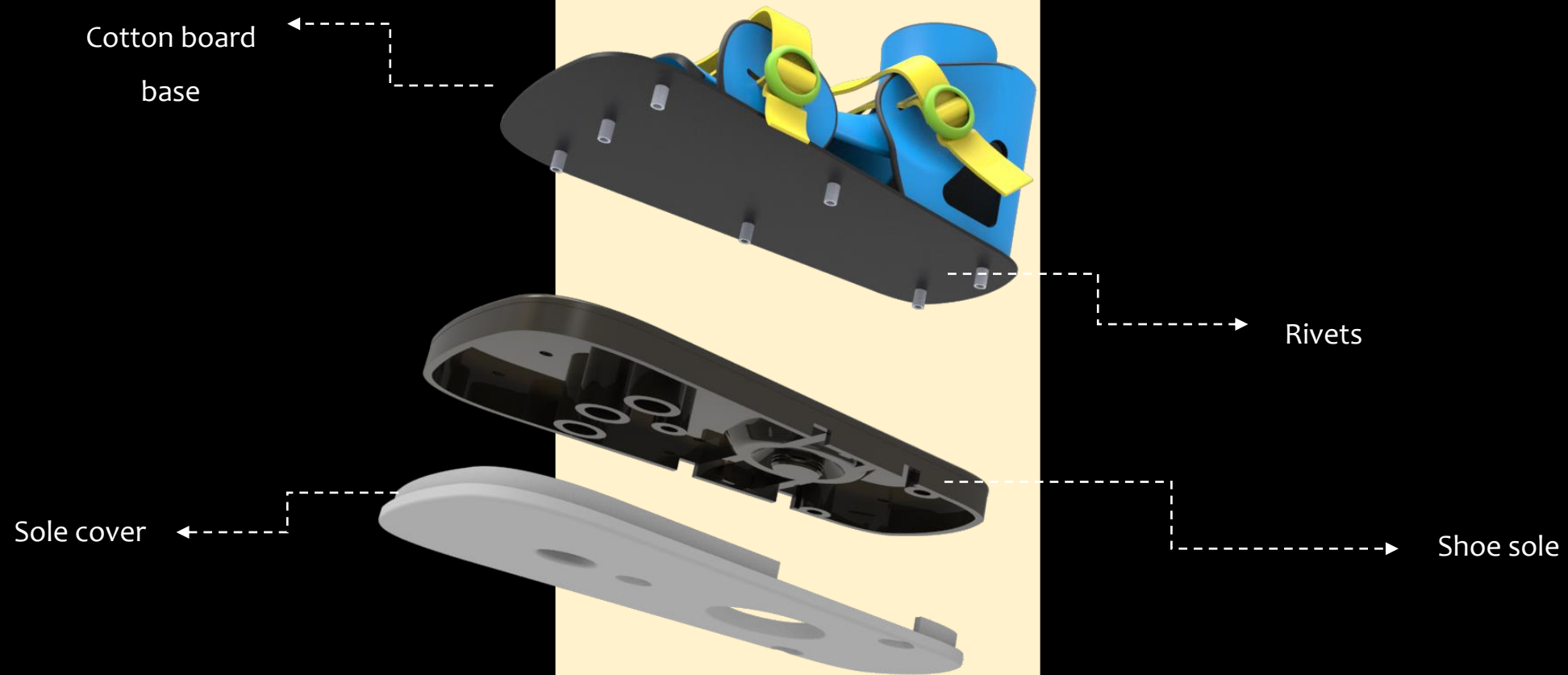
The Foot wear

- The shoe walls are constructed in two pieces.
- The straps comes separate and are Velcro fastened
- Buckles are used to tighten the straps.

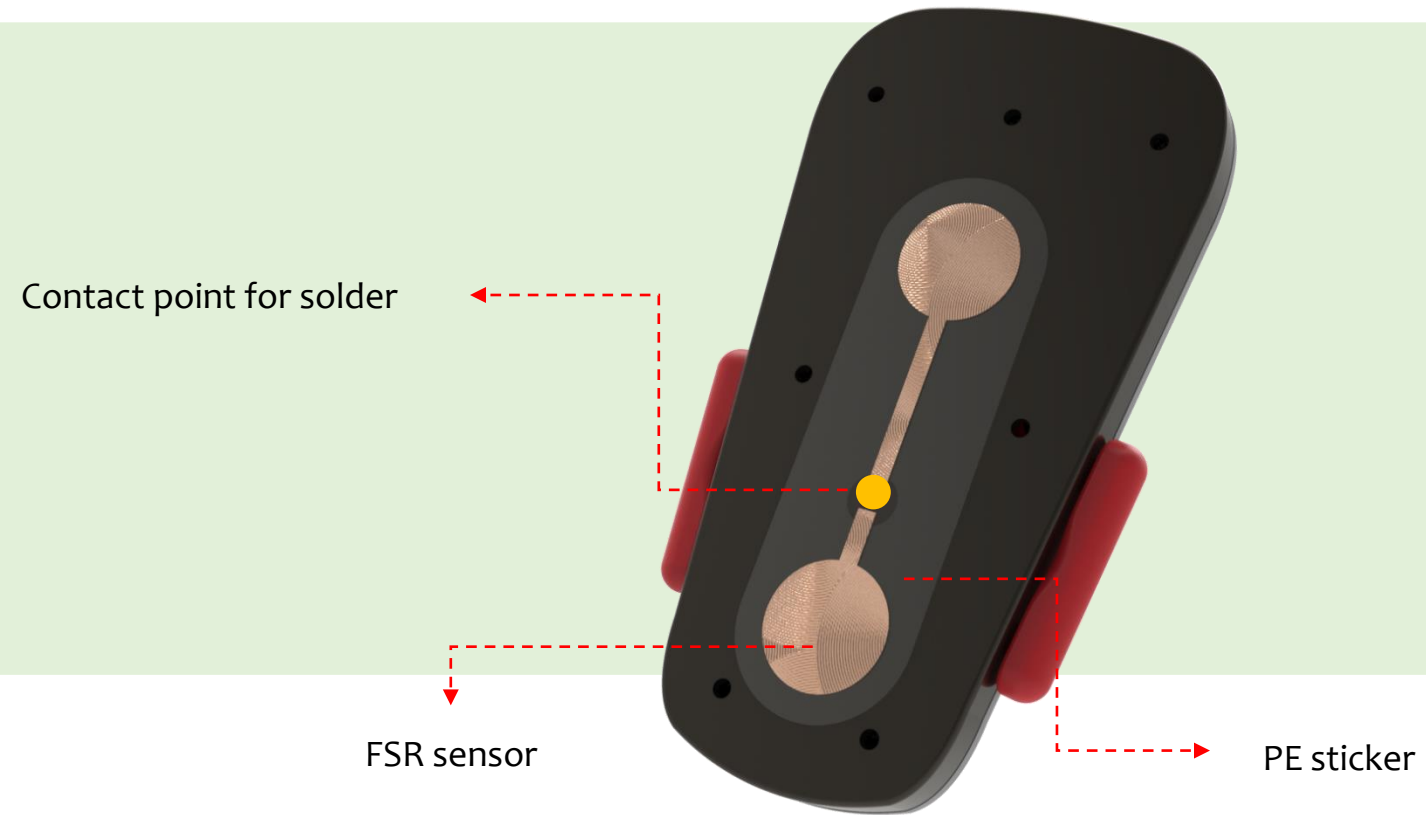


The Foot wear

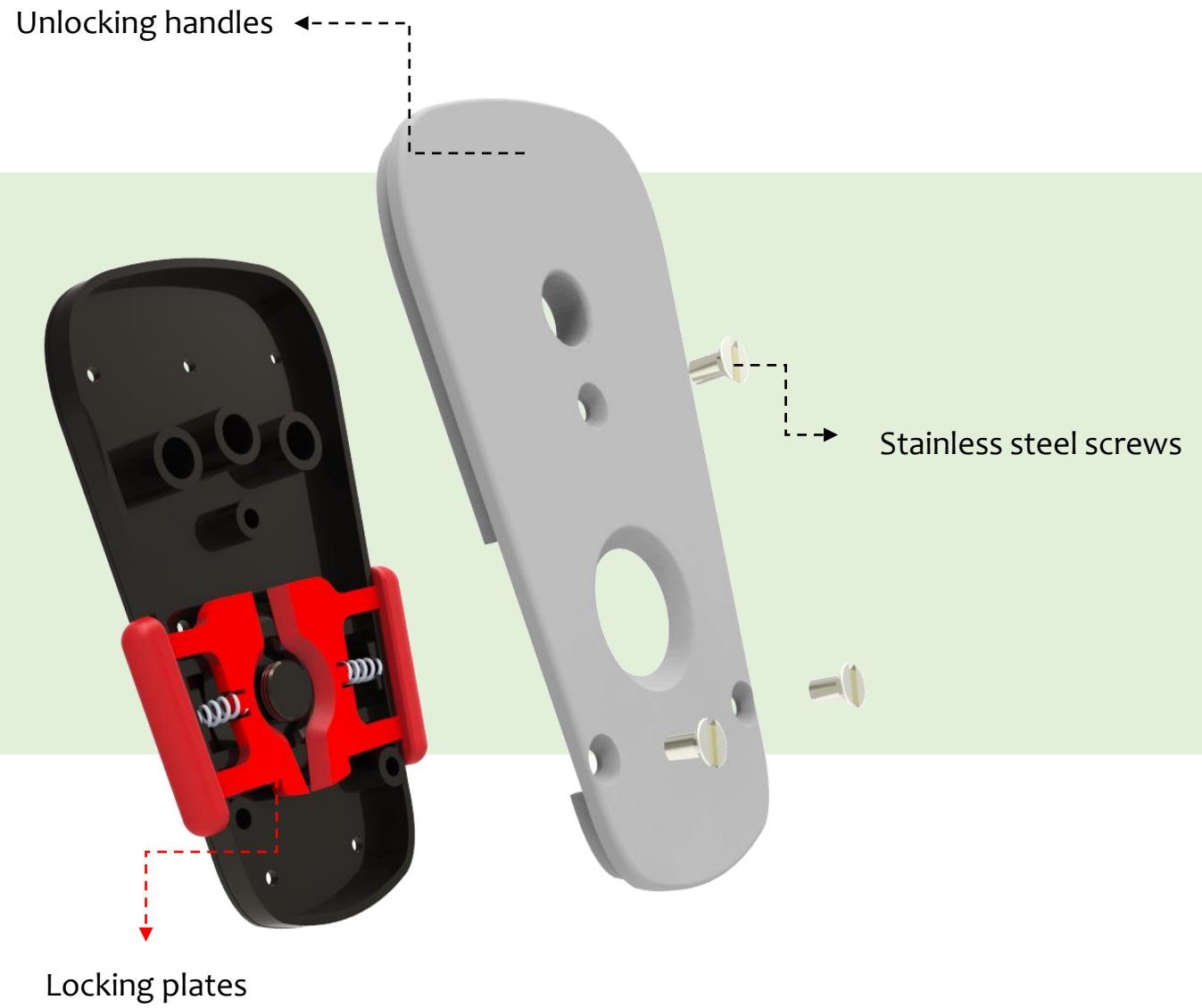


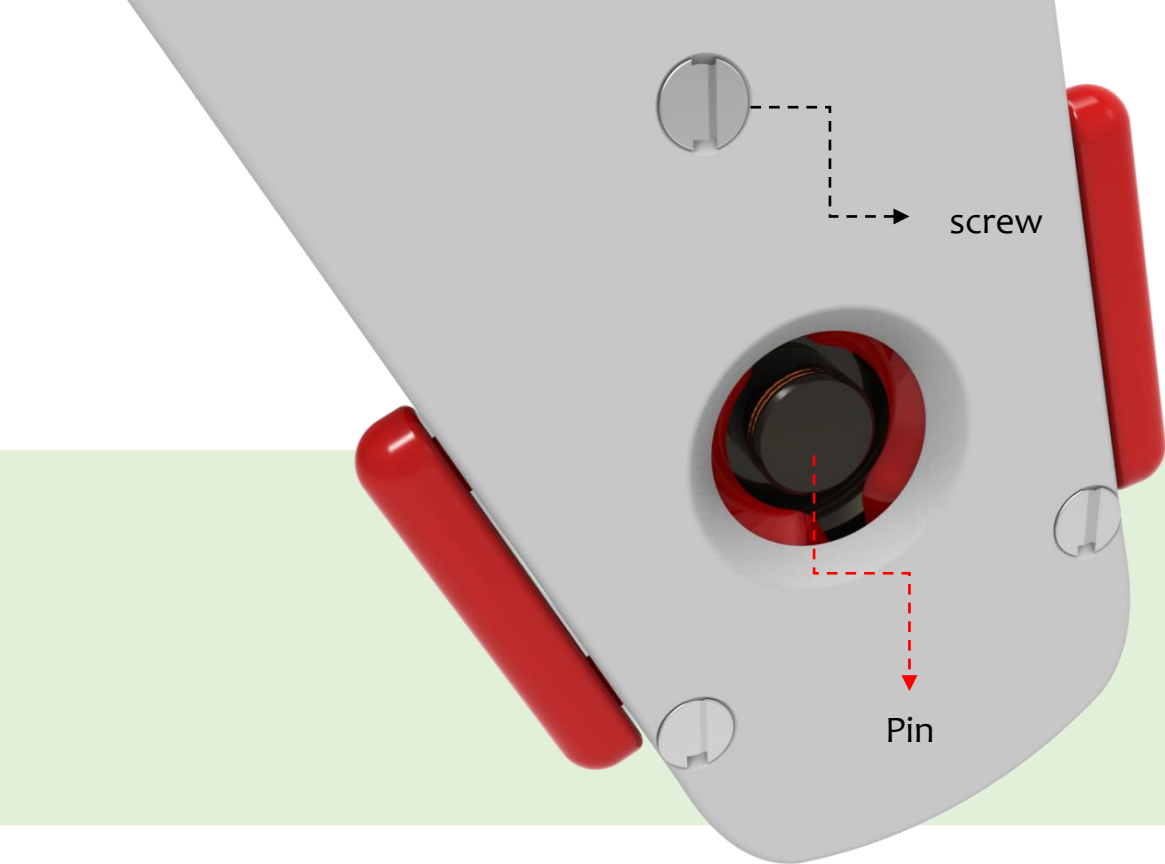


Placing the Sensors



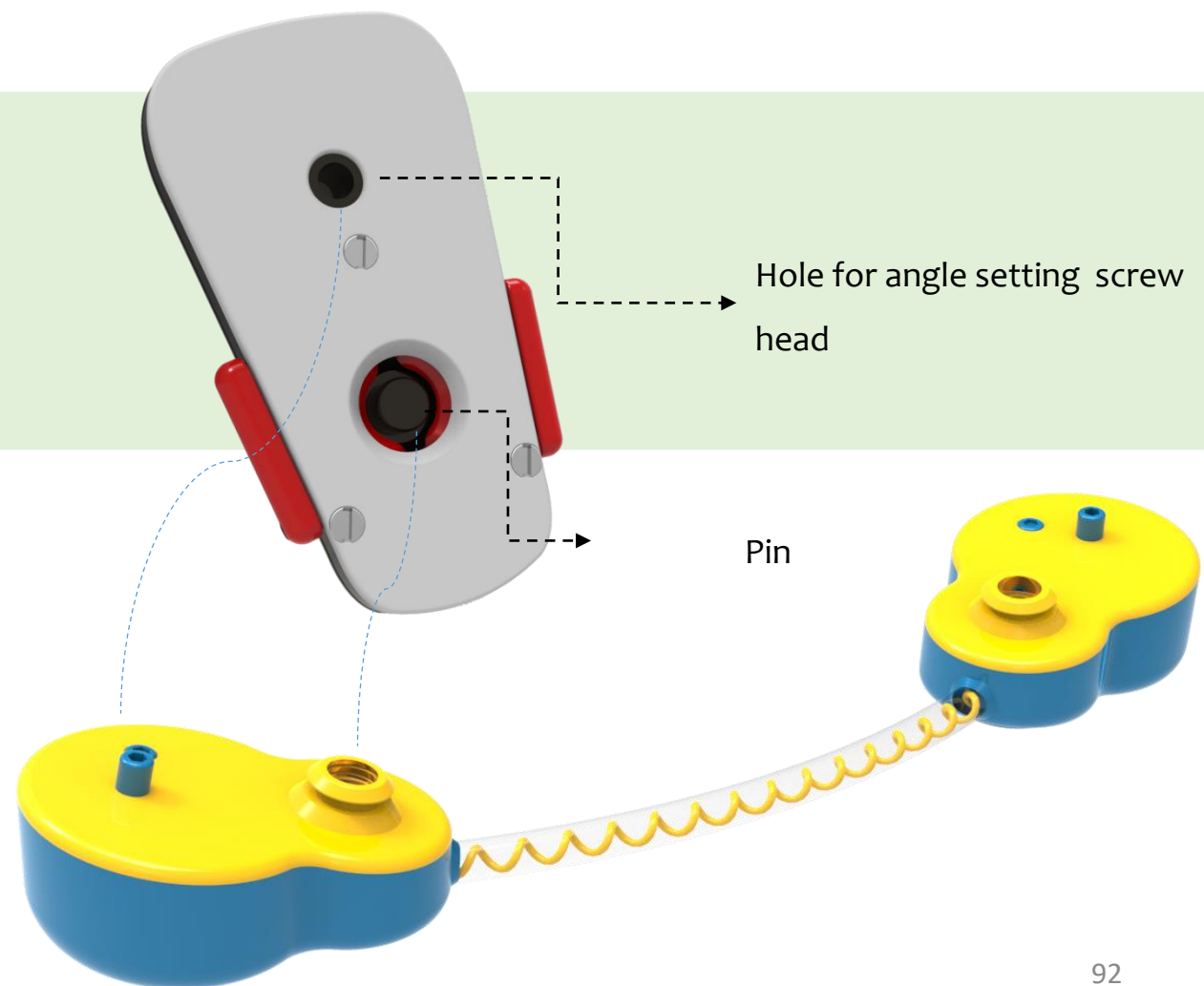
Locking Mechanism



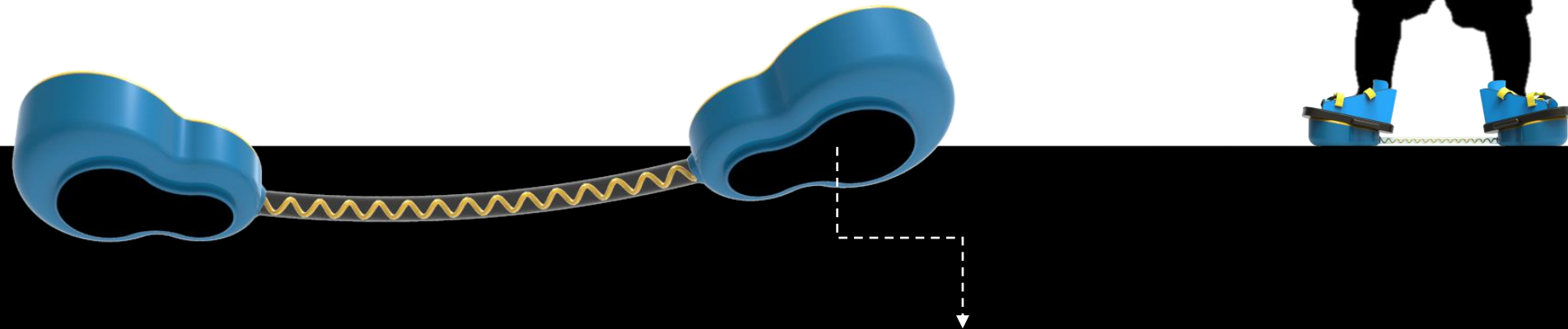


Pin & socket engagement

- The pin and the socket are coupled together to establish a connection for inputs from sensor.
- Pin and socket connection maintains the contact at connection point irrespective of any angular dislocation.



Stable Base

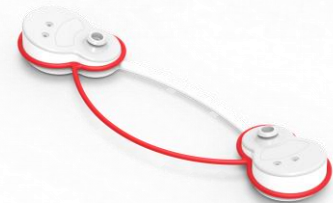
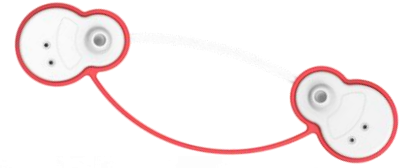
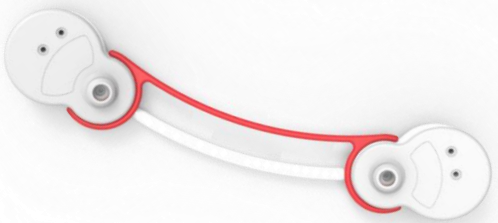
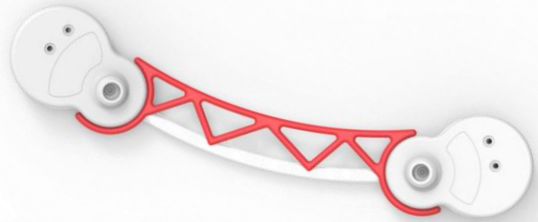


Rubber padding for
better Stiction

Exploring Space-bar

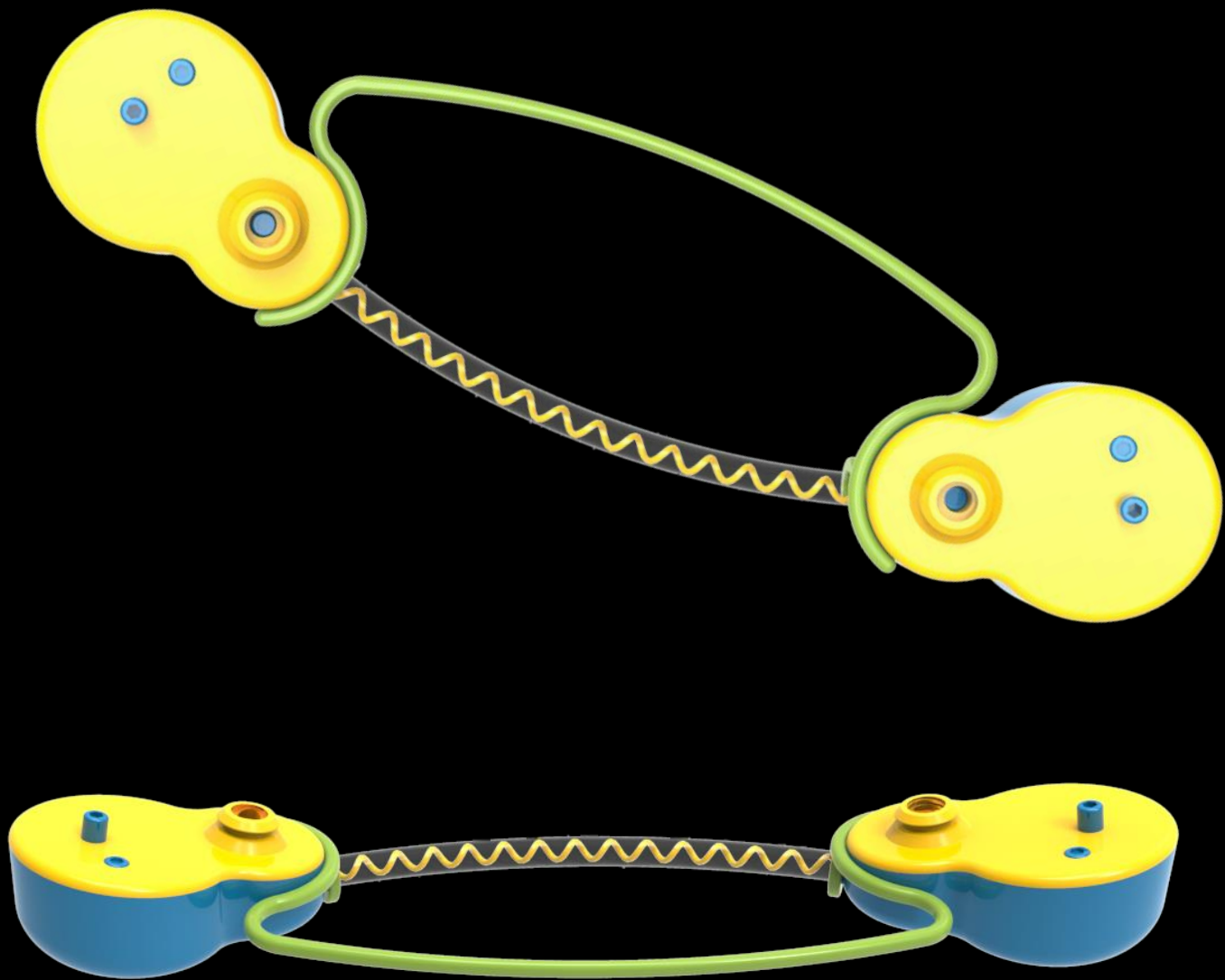
The rationale behind this attachment comes from the child's miss on relating with the present orthosis as an opportunity to interact with and Parent's discomfort of handling the braced babies.







The Space-bar





The Orthosis

The orthosis would be given to a patient as per the prescribed Brace Size and the Footwear fit. So, it would have a pair of Shoe, a Brace and the Space-Bar.

Toys for Space-bar

The major considerations for designing the toys for the bar are –

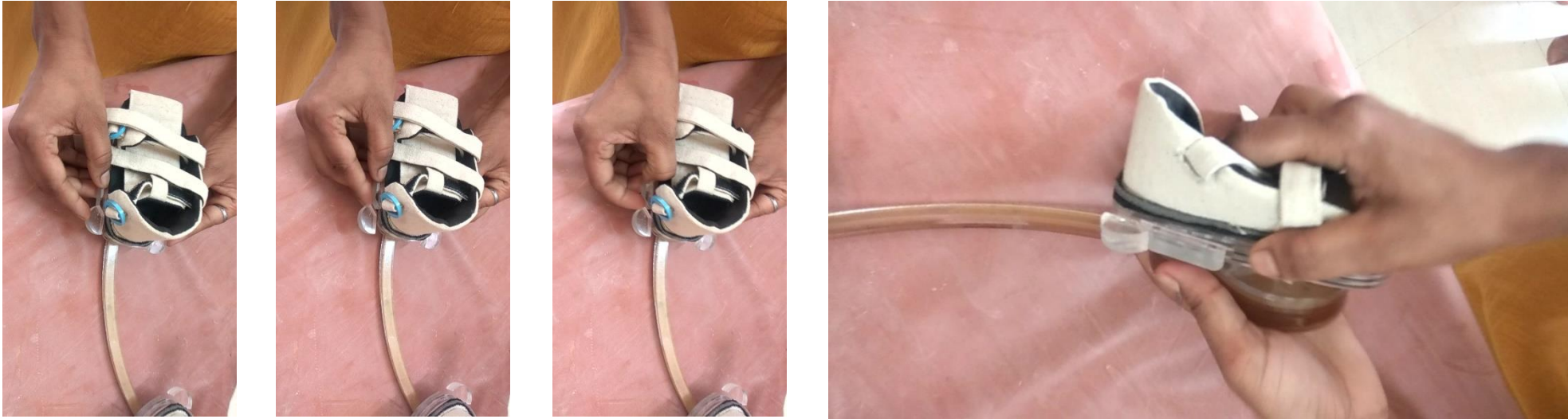
- Child's most challenging period of adapting to brace, especially, the duration of 23 hours of bracing schedule.
- Child's visual development.
- Child's physical growth, and motor skills development.
- Situations the child will be subjected
- Portability
- Variety by information
- Ease of cleaning

The inspiration for the toys came from Alphabets, Shapes, Numbers, and Motion.



User Testing & Feedback

Attempt 1



First round of feedback:

- Accessible unlocking eliminates the turning of feet to unlock as in Stanford brace.
- With lace, child will try to take off the leg out of shoe or sometimes he will try to raise his heel inside. This I did not feel with the belts as visual access is increased.
- The shoe was very quick to put on.
- The locking unlocking was difficult initially, but after I learnt it, it was very easy to lock . However , unlocking is still uneasy. An old person may not be able to open it.



Putting the shoe



Putting the brace



Attempt 2



Second round of feedback:

- Shoes are very softer and fast to do.
- Lacing is kind of frustrating , often makes us impatient.
- The locking-unlocking procedure is also very simple.
- The brace is more portable as we can detach the shoe.
- *It would be good if the brace would be lighter.*



Feedback from

Dr Sourabh Sinha

[Consultant for Clubfoot Project at BETiC]

Feedback:

- As far as functionality is concerned, the brace looks pretty good.
- The provision of brace accessory for the child is a good thought.
- As the shoes are redesigned, we need to validate them by a pilot.
- The duration while the child is wearing the brace for 23 hours, child is not mature enough to unlock the brace, so the locking can be simplified.

BRANDING



StepWell Orthosis



The logo is inspired from the form of the product, where the word *Step* is symbolically resembled by the dots and the word *Well* is expressed through the foot profile and the curls of connecting wire.

Future Scope

The next step of the project will be

- **Plastic engineering of the design,**
- **To perform simulations to optimise the design,**
- **To produce working prototypes**
- **And conduct a pilot.**

Followed by validation of design for its effectiveness of Abduction and User compliance.

The next phase of project should also focus on **specifying the shoe sizes, number of sizes and brace size standardisation.**

Once the design is validated, the brace and the shoe can be manufactured and distributed by NGOs and Clinics within to the patients.

Conclusion

- This project was an **inclusive opportunity** to understand and learn about one of the **confined health care systems, unidentified healthcare needs and conventionally accepted system/solutions in the country.**
- It surfaced the **significant scope of design intervention in health care for a developing country like India.**
- During the course of this Project, the Users and the Clinician has shown keen interest in the problem solving and spoke their hearts out about **how they lack or miss upon the precise, affordable and qualitative solutions to deal the untouched entities like clubfoot treatment.**
- The final proposed design was discussed with Clinicians and the Users, to which, the feedback given was quite positive and motivating.
- In this project, **redefining of bracing protocol was attempted** and it's actual effectiveness and scope for improvement can be more understood after prototyping and testing of the product.

Web References

1. <https://www.ncbi.nlm.nih.gov/pubmed/23586398> dated 5/02/2019
2. <https://www.nhs.uk/conditions/club-foot/> dated 5/05/2019
3. <https://doi.org/10.1111/jpc.12167> dated 7/02/2019
4. https://en.wikipedia.org/wiki/Child_development_stages dated 7/02/2019
5. <https://sciencing.com/do-bright-colors-appeal-kids-5476948.html> dated 7/02/2019
6. <https://www.nhs.uk/conditions/pregnancy-and-baby/your-baby-after-birth/#/> dated 10/02/2019
7. <https://orthoinfo.aaos.org/en/diseases--conditions/clubfoot/> dated 5/02/2019
8. https://www.who.int/surgery/challenges/esc_congenital_nomalies/en/ dated 5/02/2019
9. https://www.indexmundi.com/india/demographics_profile.html date 6/02/2019
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12. <https://www.dobbsbrace.com/dobbs-bar.html> dated 6/02/2019
13. <https://www.clubfootsolutions.org/wp-content/uploads/2017/06/Clubfoot-Solutions-Users-Manual.pdf> dated 6/02/2019
14. <https://markellshoe.com/abduction-bars.html> dated 7/02/2019
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16. <https://mdorthopaedics.easyordershop.com/link/en/bars/c/> dated 9/02/2019
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19. http://www.joas.in/temp/JOrthopAlliedSci2234-3377667_005617.pdf dated 15/02/2019
20. https://www.physio-pedia.com/Pirani_Score dated 15/02/2019
21. <https://www.clubfootsolutions.org/iowa-brace/> dated 15/02/2019
22. https://storage.googleapis.com/global-help-publications/books/help_steenbeekbrace.pdf dated 17/02/2019
23. <https://link.springer.com/article/10.1007/s00264-018-3873-3> dated 17/02/2019
24. <https://www.aoa.org/patients-and-public/good-vision-throughout-life/childrens-vision/infant-vision-birth-to-24-months-of-age?sso=y> dated 15/02/2019
25. <https://sciencing.com/do-bright-colors-appeal-kids-5476948.html> dated 19/02/2019
26. <https://www.physio-pedia.com/Prosthetics> dated 19/02/2019

Image References

FIGURE 1.1	https://orthoinfo.aaos.org/link/1da43939a3fd4d228f7bccf8af172fde.aspx
FIGURE 1.2	https://emedicine.medscape.com/article/407294-overview
FIGURE 1.3	https://www.Fyzical.Com/boerne/media/img/351574/clubfoot_intro01.Jpg
FIGURE 1.4	https://clubfootclub.org/wp-content/uploads/2010/06/ponseti-cast-card1.jpg
FIGURE 1.5	https://pro2-bar-s3-cdn-cf1.myportfolio.com/4c4c5b43d9721670b083172df179a66d/2fb8c845370215.582e157e94e1c_car_1x1.jpg?h=bc5f656a6cd4fbcc05678a05f5826of0
FIGURE 1.6	https://pro2-bar-s3-cdn-cf4.myportfolio.com/4c4c5b43d9721670b083172df179a66d/fc45bf95-76e3-4a16-a36e-807e6125e169_rw_1200.jpg?h=55e0d49dfd2886d921bob8e8ce63bddb
FIGURE 1.7	https://0515f2af61d5e3d37aec-a1d11e7882f6a6aa49a62729309b6434.ssl.cf2.rackcdn.com/2016/06/sewing-machine-web-600x400.jpg
FIGURE 1.8	https://145gjhchid5e3d37aadhgajchbsa-1d11e788j8565a49a62729309585.sl.cf2s.rackcdn.com/2016/06/club-foot-web-600x400.jpg
FIGURE 1.9	https://www.jbjs.org/elensreader.php?id=30383&rsuite_id=1705134&type=jpeg&name=JBJS.17.01049f3b&subtype=
FIGURE 1.10	https://media.springernature.com/lw785/springer-static/image/art%3A10.1007%2F00264-018-3873-3/MediaObjects/264_2018_3873_Fig1_HTML.gif
FIGURE 1.11	https://www.researchgate.net/profile/Ayman_Jawadi/publication/40900581/figure/fig1/AS:341427298029568@1458414019448/The-Pirani-score.png
FIGURE 9.2	http://lfaclinic.co.uk/wp-content/uploads/2014/11/Slide12-300x179.jpg
FIGURE 4.3	https://www.clubfootsolutions.org/wp-content/uploads/2016/12/brace_side_300x300.jpg
FIGURE 4.6	http://iowabraces.eu/assets/images/img_iowa_brace_03.jpg
FIGURE 4.7	https://www.dobbsbrace.com/images/dcb.jpg
FIGURE 4.8	https://markellshoe.com/img/img-1645e.png
FIGURE 4.9	https://markellshoe.com/img/1934d.png
FIGURE 4.10	https://www.dobbsbrace.com/images/dcb-cover.jpg
FIGURE 4.11	https://markellshoe.com/img/denis-brown-bar.jpg
FIGURE 4.12	https://markellshoe.com/img/denis-brown.jpg
FIGURE 5.36	https://image.slidesharecdn.com/12-150417055625-conversion-gate01/95/transfemoral-static-alignment-4-638.jpg?cb=1429250744

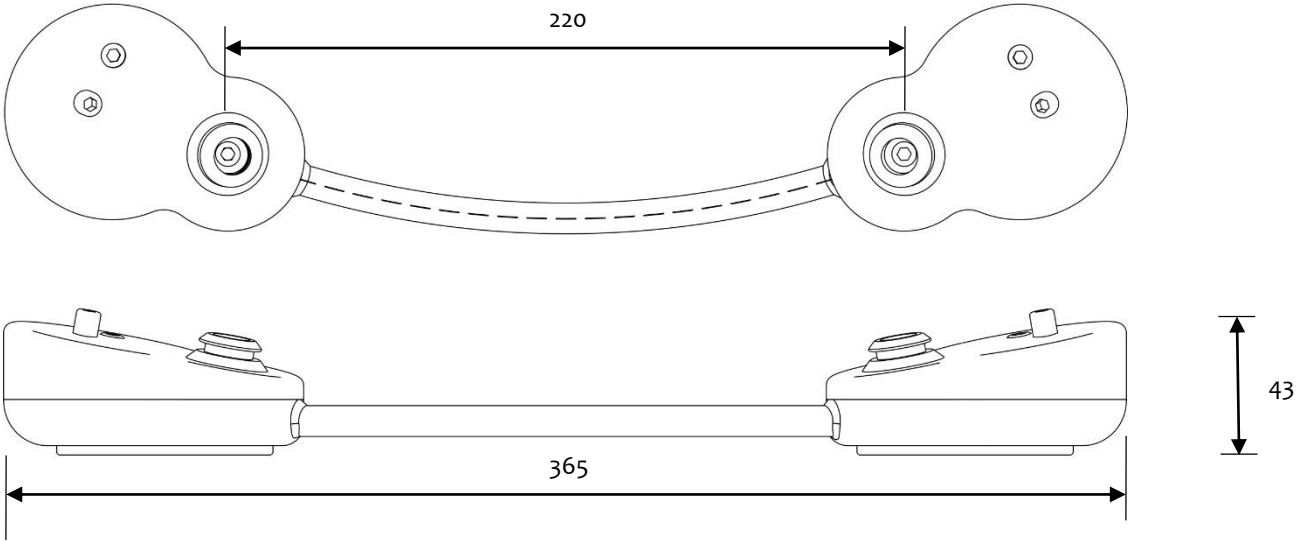
Fin.

THANK

YOU

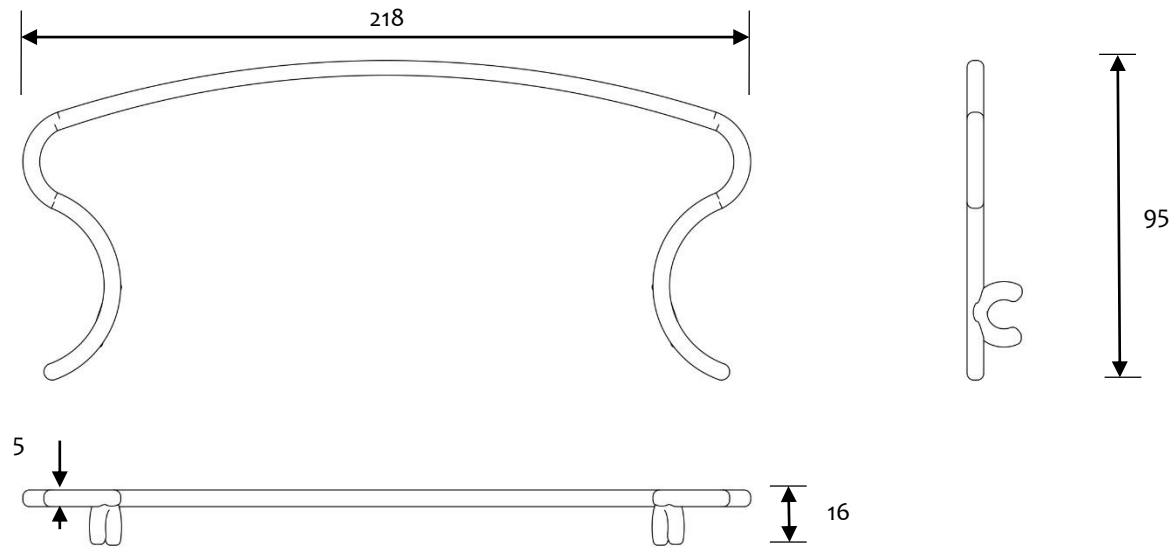
Basic Dimension

Brace



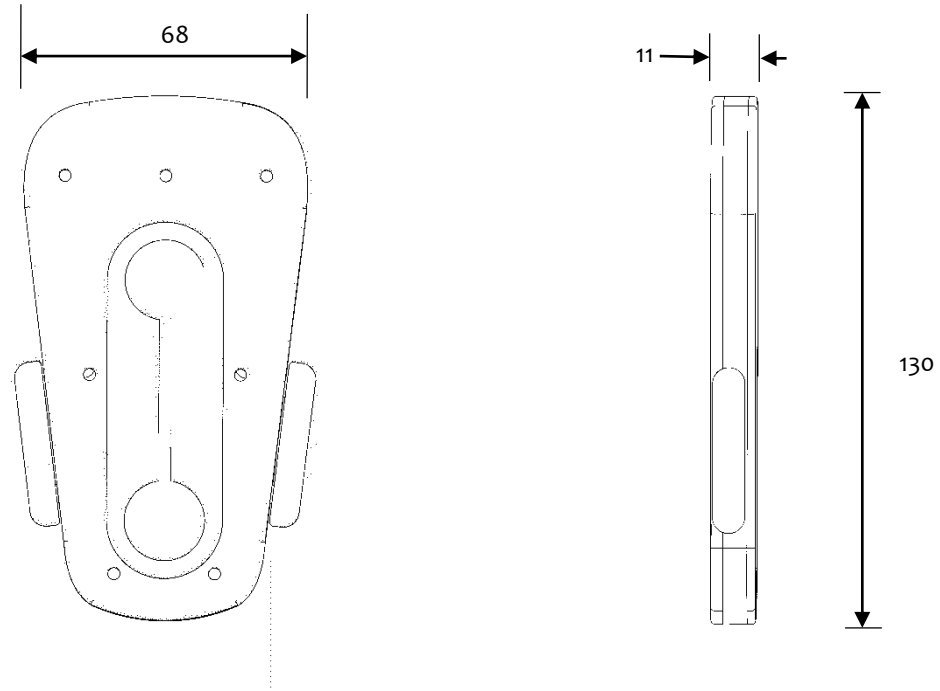
[All dimension are in mm.]

Space Bar



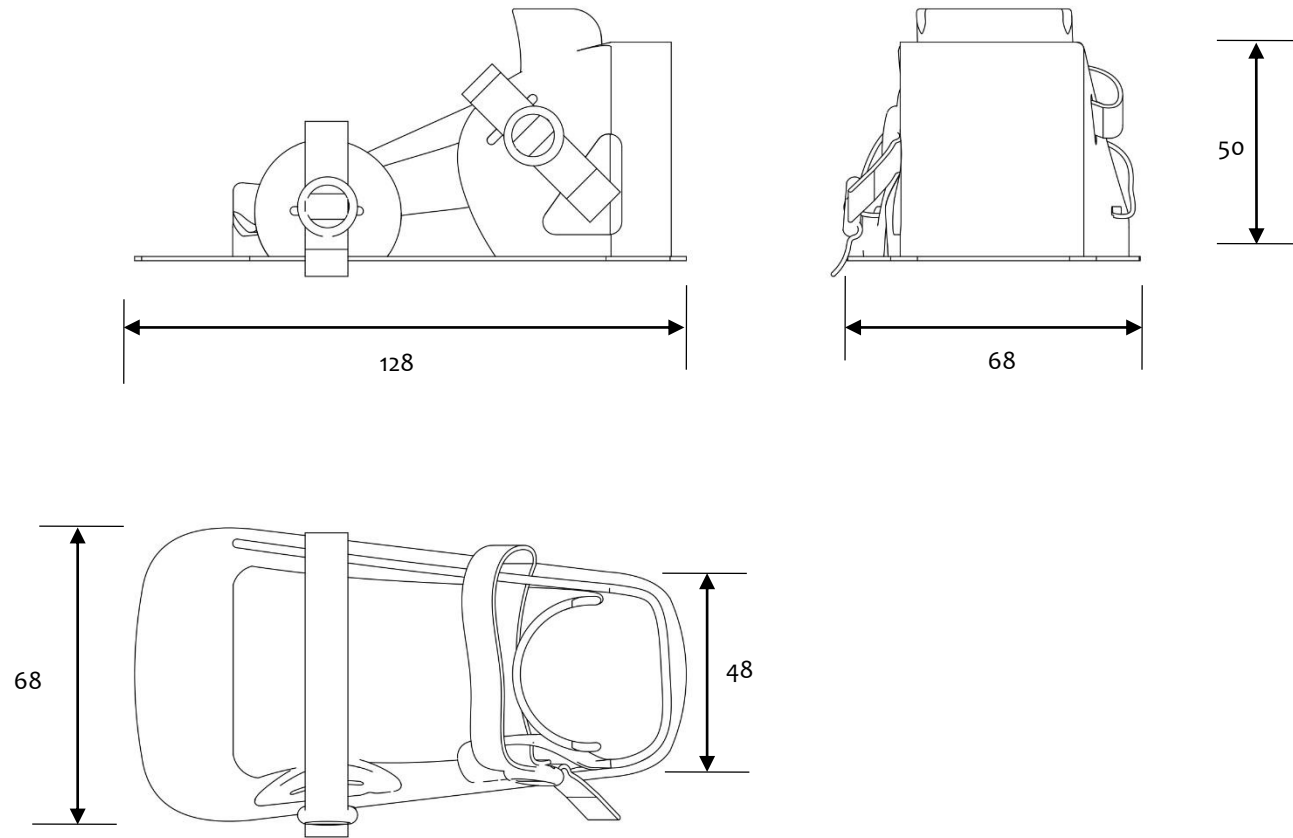
[All dimension are in mm.]

Sole box



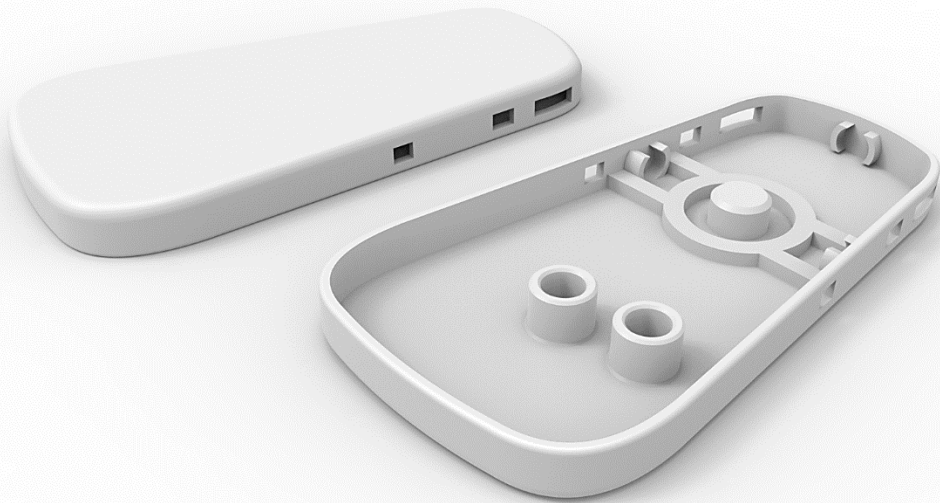
[All dimension are in mm.]

Shoe

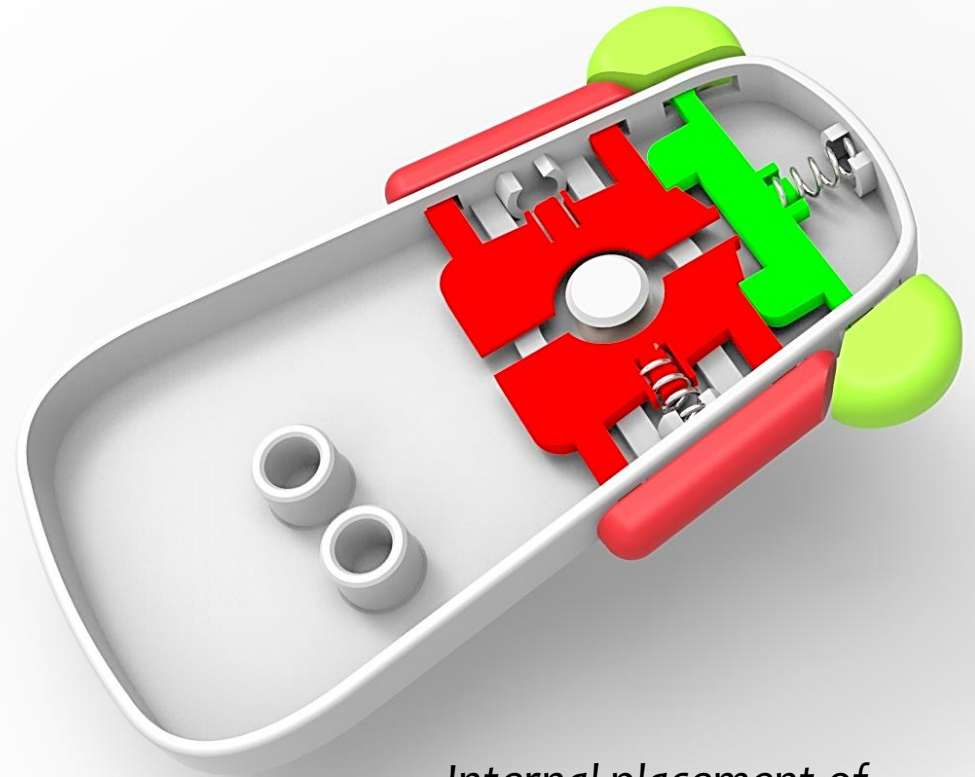


[All dimension are in mm.]

Designing the Sole Base

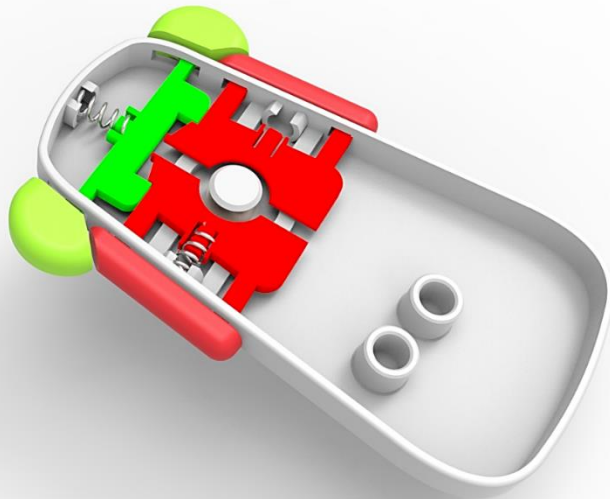


Internal structure
of the Sole Base



Internal placement of
components

Internal placement of
components



Locking by Sliding of plate
with a push

