

Redesign of a Paediatric Standing Frame



Irshath Ahamed K
156130013
2nd Year Industrial Design
Guide : Prof. P. Kumaresan
Assistant Professor
IDC IIT Bombay

Table of Content

Acknowledgements	7
Introduction	8
Objective	8
Project brief	8
1. Introduction : All about Standing	9
1.1 Why do Humans Stand Upright ?	9
1.2 How do Humans Stand Upright ?	10
1.2.1 The Human Balance System	10
1.2.2 What is balance ?	10
1.2.3 Sensory input	12
1.2.4 Input from the eyes	12
1.2.5 Input from the muscles and joints	12
1.2.6 Input from the vestibular system	13
1.2.7 Integration of sensory input	13
1.2.8 Processing of conflicting sensory input	14
1.2.9 Motor output	14
1.2.10 Posture	14

1.2.11 Correct Standing Posture	16
1.2.12 How posture develops	17
1.2.13 Why standing is important	18
1.2.14 Standing and research	18
1.2.15 The benefits of standing	19
1.2.16 Standing increases bone density and reduces the risk of fractures	19
1.2.17 Standing stretches muscles, preventing the onset of contractures	20
1.2.18 Standing improves respiration and voice control	21
1.2.19 Standing enhances circulation and blood pressure	22
1.2.20 Standing aids digestion, bowel function and bladder drainage	22
1.2.21 Standing facilitates the formation of the hip joint in early development	23
1.2.22 Standing enables kids to interact eye-to-eye with their peers	24
1.2.23 Standing improves skin integrity by relieving pressure encountered during sitting	24
1.2.24 Standing improves wellbeing, alertness and sleep patterns	25
2. All about Standing frames	26
2.1 Paediatric Stander	26
2.1.1 Who uses Standing frame ?	27
3. All about Cerebral palsy	27
3.1 What is Cerebral Palsy?	27
3.1.1 Risk Factors	28
3.1.2 About Muscle Tone	28
3.1.3 Affected Areas of the Brain	29

3.2 Types Of Cerebral Palsy	30	
3.2.1 Spastic	30	
3.2.2 Athetoid	30	
3.2.3 Dystonia	30	
3.2.4 Ataxic	30	
3.2.5 Mixed	31	
3.3 Choosing the correct stander	31	
3.3.1 Supine standers	31	
3.1.2 Prone standers	32	
3.3.3 Upright standers	32	
3.3.4 Standing and every day activities (function)	33	
3.3.5 What is the best angle for standing?	33	
3.3.6 How long should someone stand in order to gain these benefits?	34	
3.3.7 Benefits of using standing frames	34	
3.3.8 Doctors, Physiotherapists, orthopedicians, Professors, Paediatricians and Neurologists met for the project.	36	
3.3.9 Discussions with Doctors, Physiotherapists, orthopedicians, Professors, Paediatricians and Neurologists.	37	
4. Product study	39	
4.1 Existing products	39	
4.1.1 Expensive models	39	
4.1.2 Inexpensive Models	40	
4.1.3 The cheapest models	40	
4.1.4 Picking up from here	41	

5. Product examples	42
5.1 Example 1	42
5.1.1 Squiggles Stander	43
5.2 Example 2	46
6. Case Studies	53
6.1 Case 1	53
6.2 Case 2	56
6.3 Case 3	58
6.4 Indian Approach	60
7. Ideations	63
7.1 Concept 1	63
7.2 Concept 2	74
7.3 Concept 3	79
7.4 Concept 4	89
7.5 Concepts Validation	93
7.6 Concept 5	95
8. Short description of the product (elevator speech)	112
8.1 Brief Description of the product	112
8.2 Business canvas	113
8.3 Value Proposition	114

References

116

Acknowledgements

This Project owes its existence to the help, support and inspiration of several people. Firstly, I would like to express my sincere appreciation and gratitude to **Prof. P. Kumaresan** for his guidance and input during the project. His support and inspiring suggestions have been precious for the development of this report content.

I am also indebted to **Prof. G.G. Ray**, who has been a constant source of support and encouragement with his valuable input. In addition I'd also like to thank **Prof. Sandesh** and **Prof. Bapat** for their valuable input during the project presentations, as the project faculty members and advisors.

I would also like to thank all the physicians, physiotherapists, orthopedicians, paediatricians and neurologists especially Dr. Sudha who have helped me with my researches during all the stages of the project. I am very grateful to all the people I have met along the way and have contributed to the development of my research.

And finally i would also like to thank my classmates especially **Quashif** for their inputs, advices and tremendous help during the entire project.

Introduction

Objective

Is to design a standing frame for children, that is inexpensive and has all the basic features and could be used by all the children of age 16 -18 months old with cerebral palsy .

Project brief

My shortlisted topic by the faculties is to design and create a new standing frame for children with cerebral palsy. The product should be for use indoors.

Although the work should take into consideration all areas of the design process, particular attention should be paid to the, functionality, aesthetics and production cost of the proposed design concept. The final solution should have a retail value of Rs.10,000 or less.

I had a time period of 4 months to complete and submit this design brief. The final presentation should be digital and include free hand sketches and Final realistic renderings.

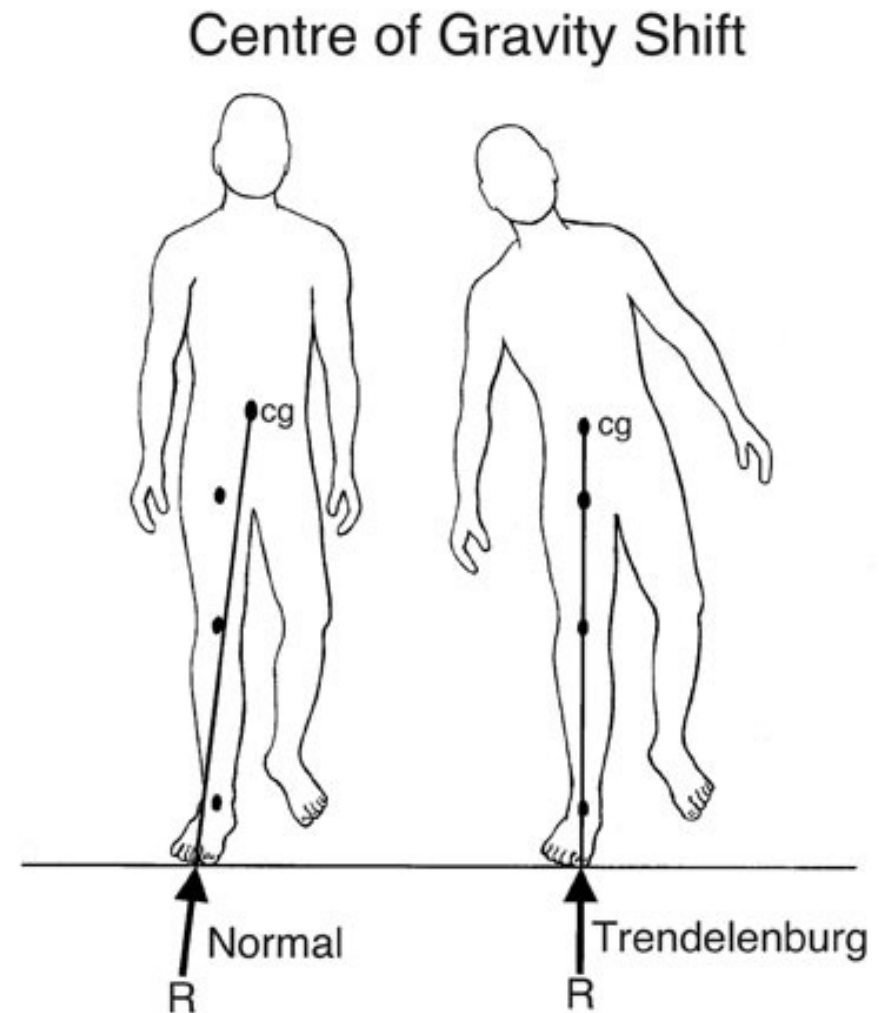
1. Introduction : All about Standing

1.1 Why do Humans Stand Upright ?

There are a number of theories as to why our ancestors evolved to walk on two legs. Some of them are patently ludicrous, but among the more sensible, the idea that we did it for cooling purposes is beautiful in its simplicity. This theory claims that we evolved to stand upright, in order to regulate our body heat in the hot conditions of ancient Africa.

Unfortunately, this theory may have taken a major blow thanks to a new piece of research. In contrast to previous attempts to model heat loss by posture, the researchers looked at how much heat would have to be discarded while walking rather than standing still. What they found was that bipedality didn't help with shedding heat in high-temperature environments — but it didn't hurt either.

What did make a big difference? Hairlessness. So while we may not have gone upright in order to cool off, losing the dense fur that marks other primates certainly helped.



1.2 How do Humans Stand Upright ?

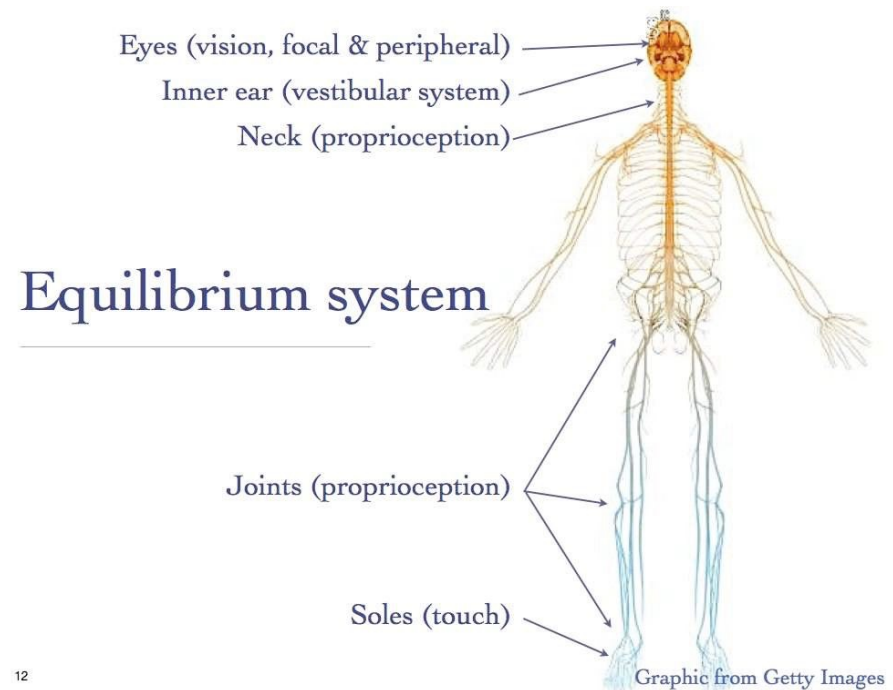
Riding the waves, the surfer displays an amazing ability to balance; the toddler meanwhile takes time fine tuning his balance skills. Of more than 250 species of primates, humans seem uniquely built for balance on two legs. How does our body keep us upright?

Balance is more than bones

Our skeleton is built with two legs containing lockable knee joints and an upright spine providing a column of support, bearing the weight of the head, neck and trunk, allowing us to maintain an upright position. Balance is, however, due to a lot more than your bones. Your ears, eyes, brain, spinal cord, heart and muscles all work together to help you stand in line at the supermarket queue.

1.2.1 The Human Balance System

Good balance is often taken for granted. Most people don't find it difficult to walk across a gravel driveway, transition from walking on a sidewalk to grass, or get out of bed in the middle of the night without stumbling. However, with impaired balance,



such activities can be extremely fatiguing and sometimes dangerous.

1.2.2 What is balance ?

Balance is the ability to maintain the body's center of mass over its base of support. A properly functioning balance system allows humans to see clearly while moving, identify orientation with respect to gravity, determine direction and speed of

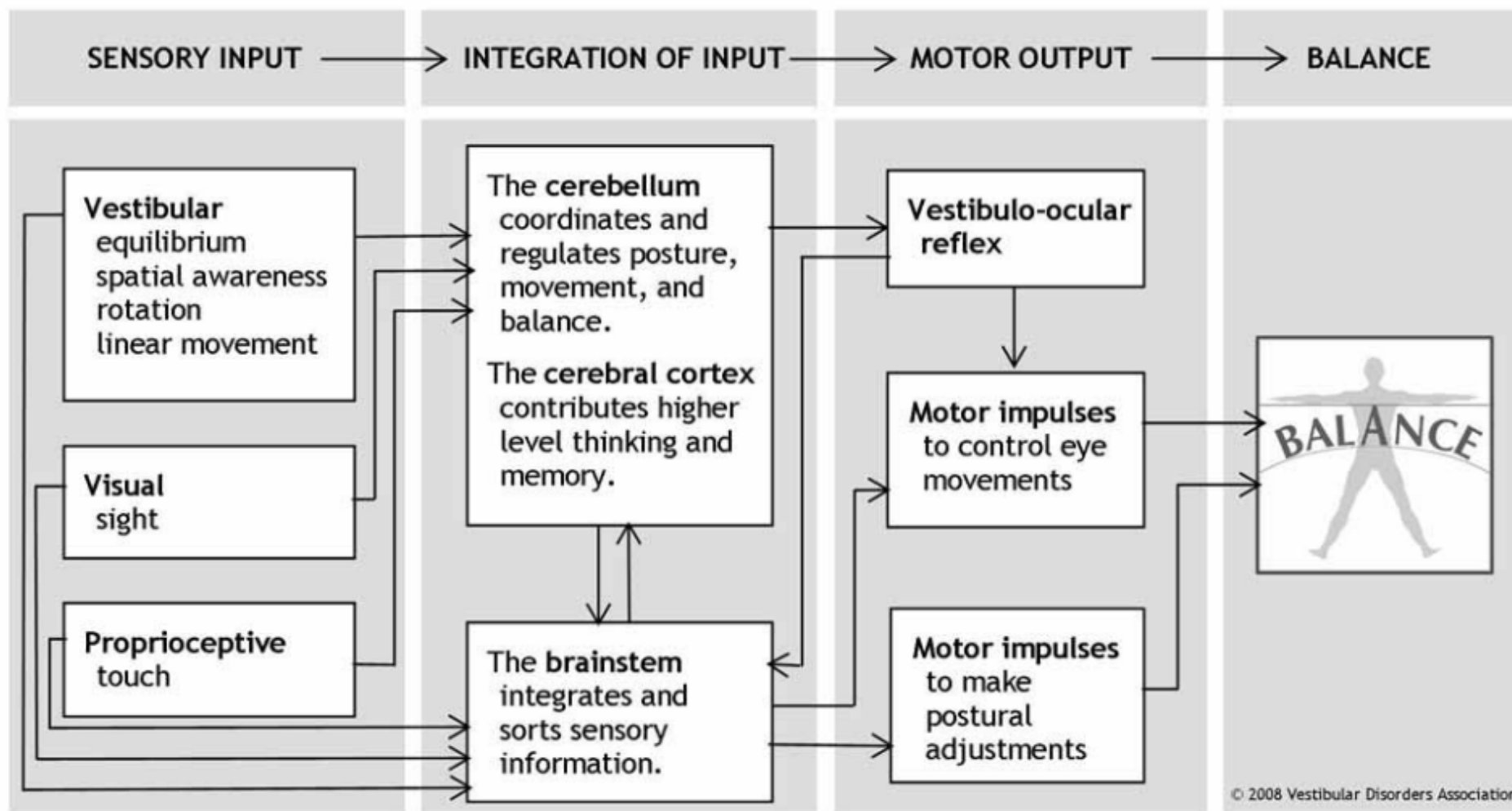


Figure 1. Balance is achieved and maintained by a complex set of sensorimotor control systems.

movement, and make automatic postural adjustments to maintain posture and stability in various conditions and activities.

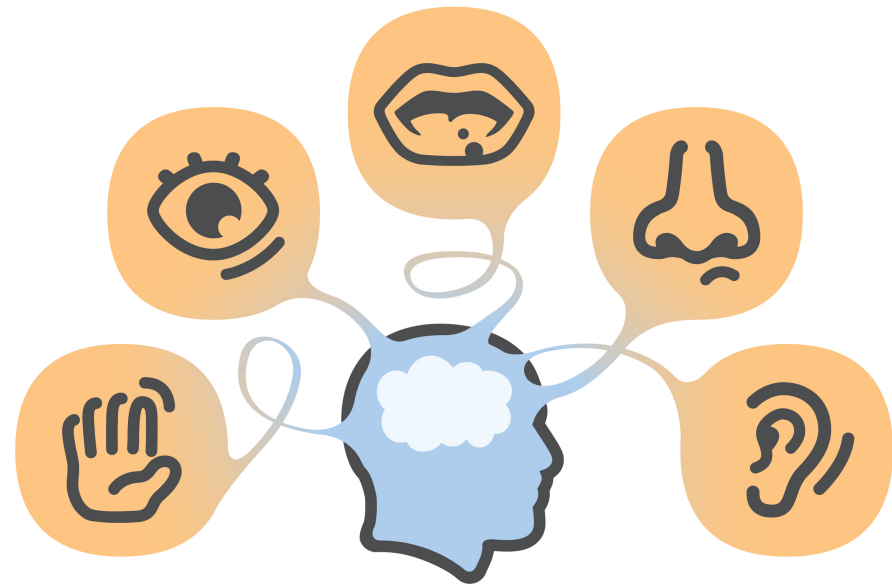
Balance is achieved and maintained by a complex set of sensorimotor control systems that include sensory input from vision (sight), proprioception (touch), and the vestibular system (motion, equilibrium, spatial orientation); integration of that sensory input; and motor output to the eye and body muscles. Injury, disease, or the aging process can affect one or more of these components.

1.2.3 Sensory input

Maintaining balance depends on information received by the brain from three peripheral sources: eyes, muscles and joints, and vestibular organs. All three of these sources send information to the brain in the form of nerve impulses from special nerve endings called sensory receptors.

1.2.4 Input from the eyes

Sensory receptors in the retina are called rods and cones. When light strikes the rods and cones, they send impulses to the brain that provide visual cues identifying how a person is oriented relative to other objects. For example, as a pedestrian walks



along a city street, the surrounding buildings appear vertically aligned, and each storefront passed first moves into and then beyond the range of peripheral vision.

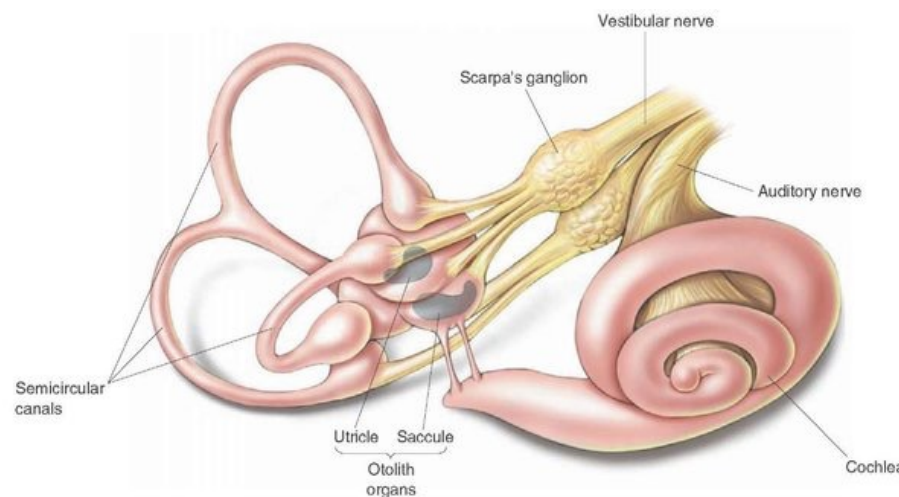
1.2.5 Input from the muscles and joints

Proprioceptive information from the skin, muscles, and joints involves sensory receptors that are sensitive to stretch or pressure in the surrounding tissues.

The sensory impulses originating in the neck and ankles are especially important. Proprioceptive cues from the neck indicate the direction in which the head is turned. Cues from the ankles indicate the body's movement or sway relative to both the standing surface (floor or ground) and the quality of that surface (for example, hard, soft, slippery, or uneven).

1.2.6 Input from the vestibular system

Sensory information about motion, equilibrium, and spatial orientation is provided by the vestibular apparatus, which in each ear includes the utricle, saccule, and three semicircular canals. The utricle and saccule detect gravity (vertical orientation) and linear movement. The semicircular canals, which detect rotational movement, are located at right angles to each other and are filled with a fluid called endolymph. When the head rotates in the direction sensed by a particular canal, the endolymphatic fluid within it lags behind because of inertia and exerts pressure against the canal's sensory receptor. The receptor then sends impulses to the brain about movement. When the vestibular organs on both sides of the head are functioning properly, they send symmetrical impulses to the brain. (Impulses originating from the right side are consistent with impulses originating from the left side.)



1.2.7 Integration of sensory input

Balance information provided by the peripheral sensory organs, eyes, muscles and joints, and the two sides of the vestibular system—is sent to the brain stem. There, it is sorted out and integrated with learned information contributed by the cerebellum (the coordination center of the brain) and the cerebral cortex (the thinking and memory center). The cerebellum provides information about automatic movements that have been learned through repeated exposure to certain motions.

1.2.8 Processing of conflicting sensory input

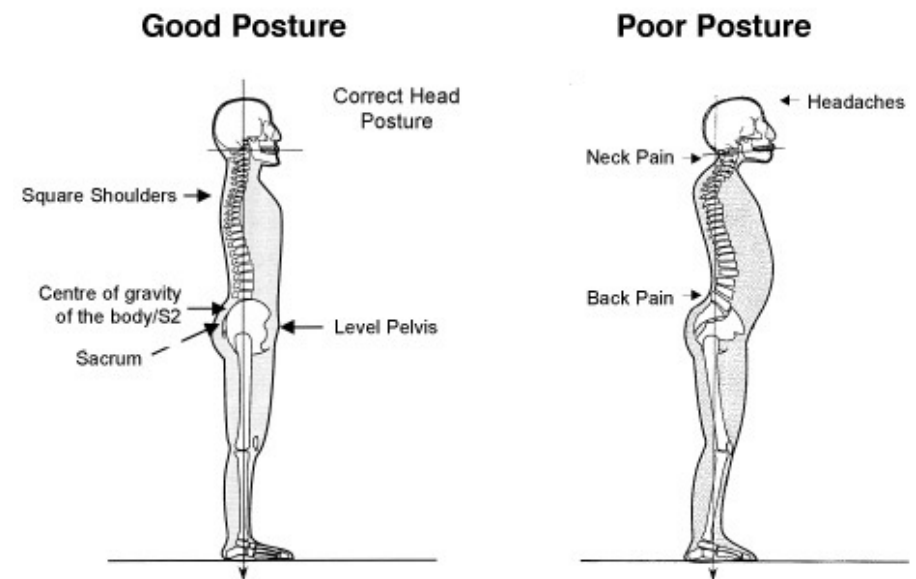
A person can become disoriented if the sensory input received from his or her eyes, muscles and joints, or vestibular organs sources conflicts with one another. For example, this may occur for example, when a person is standing next to a bus that is pulling away from the curb. The visual image of the large rolling bus may create an illusion for the pedestrian that he or she rather than the bus is moving. However, at the same time the proprioceptive information from his muscles and joints indicates that he is not actually moving. Sensory information provided by the vestibular organs may help override this sensory conflict. In addition, higher level thinking and memory might compel the person to glance away from the moving bus to look down in order to seek visual confirmation that his body is not moving relative to the pavement.

1.2.9 Motor output

As sensory integration takes place, the brain stem transmits impulses to the muscles that control movements of the eyes, head and neck, trunk, and legs, thus allowing a person to both maintain balance and have clear vision while moving.

1.2.10 Posture

Human posture can be defined as, “the position of one or many body segments in relation to one another and their orientation in space” (Ham et al, p26). The head, trunk, pelvis, lower limbs and feet are known as body ‘segments’, while spinal joints, hips, knees, ankle and shoulder joints are considered the body ‘linkages’ (Pope 2002).



Human posture is influenced by a number of interconnected factors:

- muscle tone (i.e. high or low)
- body shape and size (i.e. height and weight)
- gravity
- the surface (e.g. uneven ground, slopes, sand, footwear)
- the task in hand
- length of time required to be in a particular posture
- level of health, well-being or emotional state

Therefore, posture can be seen as the inter-relation and inter-dependency between:

- comfort
- stability
- function (including movement)

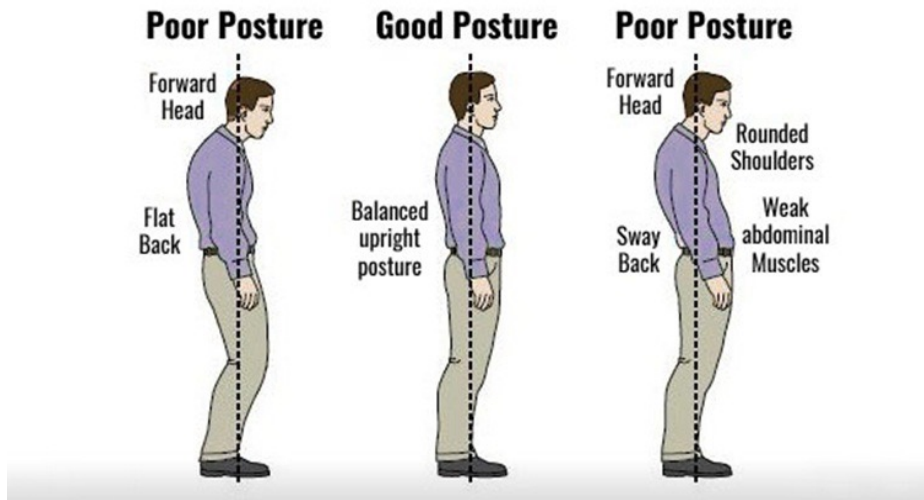
In the absence of stability, function (for example, the ability to play, use communication devices or do schoolwork) is impaired. However, stability can only be achieved with some degree of comfort. Function may be achieved in the absence of comfort or with minimal stability, but it will be short-lived. The balance

must be struck between comfort, stability and function, depending

on the task in hand and the environment. Therefore posture is important because it supports a vast range of daily functions, in addition to supporting internal processes such as breathing, vision, digestion, circulation, temperature regulation. Humans need to be able to operate in a variety of environments, for a variety of reasons and hold themselves upright against gravity. When considering posture it should be seen as an active and dynamic process which underpins movement and function (Hong, 2005). Howe and

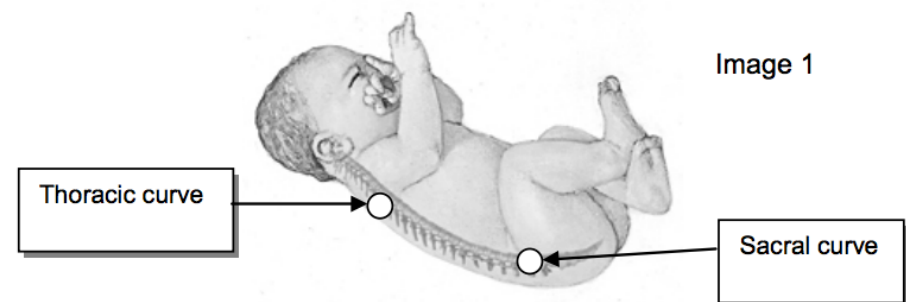
Oldham (2001) also highlight that posture and movement are inextricably linked, referring to posture as a temporary arrested movement, which is in a constant state of change.

1.2.11 Correct Standing Posture

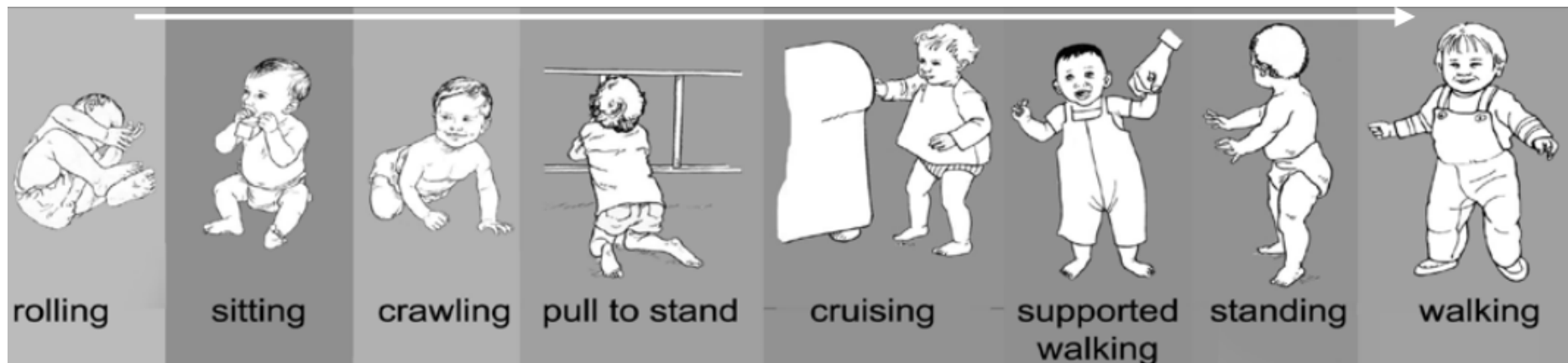


Good standing posture is important for health. From a medical perspective good posture means under relaxed conditions the body can still maintain a proper balance line. When standing up, the back is kept straight so that the internal organs can be maintained in the proper position and the burden borne by the back becomes less. Improper standing posture tends to make the lumbar spine curvature excessively, causing pain in the lower back. Generally, maintaining the neutral spine position while standing up is the proper posture. The chin should be pulled back and eye sight should be held at approximately two to three

metres to the front. Proper standing posture requires strong muscle and joints in both feet. Walking can strengthen the muscles of the feet and it is an effective exercise to maintain proper posture. If one forms a habit of walking in daily life and uses the stair case instead of the lift or escalators in the MTR train stations and department stores, it helps train the muscles and joints of the feet. Alternatively, standing for a long time also poses health risks. For example it could cause poor blood circulation of the lower limbs. That in turn may cause varicose veins in the legs. Also, the soles of the feet are under pressure for a long time which may result in plantar fasciitis. So people who always have to stand at work, such as teachers, sales persons, waiters etc., should move around or do some stretching exercises when they are standing to improve vein circulation of the lower limbs. Besides, choosing suitable work shoes can also



help.



1.2.12 How posture develops

When babies are born they have a predominantly flexed (C-shaped) posture with two primary spinal curves known as the thoracic curve (mid back) and sacral curve (bottom)

In the usual sequence of events, babies move through developmental stages almost seamlessly.

As they learn postural control against gravity their spines develop secondary extension curves in the cervical (neck) region first (holding their heads up against gravity when on their tummy or hands and knees) and lumbar region (lower back) as they gain sitting and standing balance.

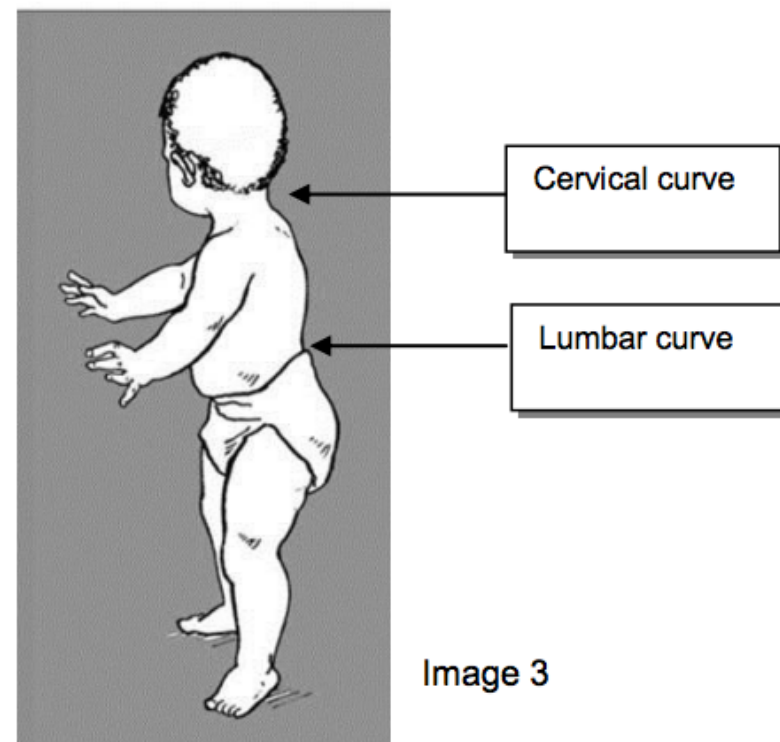


Image 3

Postural control requires achieving normal developmental milestones and includes the maturing of postural reactions (righting, protective and equilibrium reactions), the integration of primitive reflexes (asymmetrical tonic neck reflex, symmetrical tonic neck reflex, tonic labyrinthine reflex), as well as normal muscle tone, normal postural tone and intentional voluntary movements (Wandel 2000).

1.2.13 Why standing is important

Human beings are designed to stand. When development is unhindered, children start pulling themselves to a standing posture from as early as nine months old. This naturally progresses to cruising along furniture, then walking with hands held, to independent walking from approximately 12 months old. The ultimate goal is being able to move from one place to another at will, and achieve all the day-to-day play, self-care and school or work activities that are still to be learned. When development is seamless, we take this progression for granted, and don't stop to think how important the upright posture is. However, when children have moderate to severe physical disabilities (for example, cerebral palsy, spina bifida, muscular dystrophy, developmental delay, osteogenesis imperfecta [brittle bones] or acquired injuries) which prevent them from weight bearing independently, this developmental progression may not

take place or skills already gained may be lost. Independent standing or walking may not be achievable. Therefore developing or maintaining an upright posture using specially designed standing frames becomes highly important.

1.2.14 Standing and research

Clinicians are expected to support their clinical decision-making using a process of evidence based practice. The highest level of research evidence is the double blinded randomised control trial (RCT) commonly used in drug trials. This is when neither participants nor researchers are aware of who belongs to the experimental group and who belongs to the control group. It is considered "gold-standard" level because it removes many of the confounding variables which can be found in other research methodologies, therefore reducing the likelihood of the outcome being down to chance.

However, when we think of children with disabilities and standing frames, it is neither practical nor ethical to take this sort of approach. It would not be possible to prevent children, therapists and researchers from knowing who was using a stander and who was not (it would be obvious), nor is it ethical to withhold treatment (as would be necessary for a control group) when there is no evidence that standing is not beneficial.

Therefore researchers have no choice but to use alternative study designs, which although may be perceived as less rigorous in research terms, are more suited to the complex variables which affect individuals with disabilities. For example, a group of 10 year old children with Cerebral Palsy Spastic Quadriplegia will not present clinically in exactly the same way. In addition there are many other extraneous factors which cannot be controlled for by researchers - such as social circumstances or other medical issues. As a result, researchers invariably have small sample numbers, or use case series or single case study designs. This does not reduce the value of the research, and in terms of evidence based practice, clinicians must use the best available evidence to them. Expecting research with this population of clients to be a gold-standard RCT is asking the impossible.

1.2.15 The benefits of standing

However, as with most topics about postural management, published research evidence is limited regarding the effectiveness of using standing frames. Nonetheless the research that exists, along with other published material, and the clinical experience of therapists, indicate significant benefits of standing for a range of physiological and psychological reasons.

1.2.16 Standing increases bone density and reduces the risk of fractures



Bone density is a measure of bone strength and strong bones are more resistant to fractures. Normal bone growth and development needs a combination of good nutrition, weight-bearing (loading of the bones against gravity, for example, standing, walking or running), and the use of muscles (Pope, 2007). Therefore children with conditions which inhibit them from doing these things lose bone density (Clarke, 2010; Pope, 2007). Paleg (2008) as part of a larger systematic review, examined 10 good quality research studies published from 1964 to 2006 which looked at the effects of standing on the bone density of non-ambulatory, spinal cord injured or cerebral palsied children. All but one study report increases in bone

density. A more recent study by Alekna et al (2008) assessed bone mineral loss in people with a spinal cord injury (SCI) and how weight-bearing activity (passive standing) affected this during the first two years post-injury. The sample size was 64, with people choosing their own intervention programme: Group A – those with regular physiotherapy and a standing programme (1 hour 5 days per week); and Group B – regular physiotherapy intervention.

Results indicated that after one year, both groups had reduced BMD which was not statistically significantly different. However, after two years patients in the standing group had statistically significantly higher BMD in the legs and in the pelvis, in comparison with non-standing patients.

Therefore the authors concluded that a standing programme has a statistically significant effect in the longer term on reducing the loss of bone mineral density in the lower extremities and pelvis in those with SCI. There are also many clinical publications which reiterate that bone density is maintained or improved by standing.

1.2.17 Standing stretches muscles, preventing the onset of contractures



When children are unable to stand independently due to increased muscle tone, weakness or imbalance, they are at risk of shortening (contracture) of the muscles which bend the hip (iliopsoas); those which straighten the hip and bend the knee (hamstrings); the calf muscle which bends the knee and points the toes (gastrocnemius); and/or the calf muscle which points the toes (soleus) (Salem et al, 2010; Hagglund 2009; Young, 2008; Pope, 2007). Together the tendons of gastrocnemius and soleus are more commonly known as the Achilles tendon. Krueger & Coleman (2010) and Meyer (2008) argue that standing provides proprioceptive input (the feedback from joints and muscles which tells you where your body parts are in space

without looking at them) to young developing muscles and joints and therefore builds endurance to standing and regulate resting muscle tone. Watanabe (2010) and Hicks (2008) add that the stretch provided by changing position alleviates pain. Paleg's 2008 systematic review included 32 research articles published from 1981 to 2008 about the effects of standing on motor ability, spasticity and range of movement. While the studies vary in research design, all report some level of improvement regarding movement ability, reduction in spasticity or increased range of movement. In addition, a more recent study by Gibson et al (2009) examined whether static weight-bearing in a standing frame affected hamstring length and ease of activities of daily living (ADLs) in nonambulant children with cerebral palsy. Using an ABABA design where A=regular physiotherapy intervention (6 weeks); and B=regular physiotherapy intervention + standing programme (standing for 1 hour, 5 days per week for 6 weeks). Six children participated. Results showed that participants' hamstrings significantly lengthened during the first standing phase.

Gibson et al's results indicate that prolonged standing significantly improves extensibility of the hamstrings, and also show that it enables the child to carry out ADLs with more ease. However, standing programmes need to be maintained to have continued benefit for the child. Clinical publications also

promote standing for stretching these muscle groups in addition to improving the joint ranges of movement, and reducing spasticity.

1.2.18 Standing improves respiration and voice control



When we breathe in, the thin muscle which separates the chest cavity from the stomach cavity (diaphragm) becomes smaller (contracts). In turn, this expands the chest cavity, allowing our lungs to suck in air. When we breathe out, the opposite happens. So when we stand, the diaphragm has more room to expand and contract, meaning we can breathe in and out more easily, deeply and efficiently (Labandz, 2010; Watanabe, 2010; Wechsler, 2009; Meyer, 2008). Paleg's 2008 review includes 3 articles published from 1995 – 2001 which specifically report improved breathing. Meyer (2008) describes how individuals can speak with

improved volume due to greater breath support, aiding communication; while Krueger & Coleman (2010) goes further, observing that standing during play and therapy increases vocalization and use of language in general. (Labandz, 2011 & 2010; Wechsler, 2011; Dobrich, 2010; Puliti, 2010; Miles, 2008; MogulRotman, 2008).

1.2.19 Standing enhances circulation and blood pressure



Effective circulation is closely related to breathing, as it is the efficient supply of oxygen to the blood, followed by the efficient pumping of this oxygenated blood to the rest of the body which helps to keep us healthy. Paleg's 2008 review identified 9 articles published between 1964 – 2007 which reported improvements in participants' blood pressure (reduced orthostatic hypotension – the sudden drop in blood pressure when standing), heart rate,

and circulation and decreased swelling (oedema) in legs and feet. More recent clinical commentaries also support standing for improved circulation (Miles, 2010 & 2008; Wechsler, 2010); cardiac exercise (Watanabe, 2010; Mogul-Rotman, 2008); and oedema (Mogul-Rotman, 2008).

1.2.20 Standing aids digestion, bowel function and bladder drainage



Standing is believed to help with digestion and toileting through a combination of gravity (Wechsler, 2011; Watanabe, 2010; Meyer, 2008; and the activation of the stomach muscles (Labandz, 2010). From a research evidence perspective, Paleg's 2008 systematic review reveals more evidence to support digestion and bowel function than bladder drainage. Seven studies (1990 – 2007) looking at digestion and bowel function (in spinal cord injured [SCI] or elderly participants) reported up

to 53% improvement in the regularity and time spent in bowel clearance. By comparison, only 4 studies (1998 – 2001) looked at bladder function in SCI participants, again with up to half of participants reporting either improvements in bladder emptying or reduction in urinary infections. One study reported by Paleg (2008) demonstrated in “normal” participants that bladder pressure increased 2-3 fold with a 60° tilt from supine indicating that a more upright posture is more efficient for bladder awareness and emptying. Many clinical commentaries also support the use of standing for digestion and bowel/bladder function (Labandz, 2011 & 2010; Wechsler, 2011; Dobrich, 2010; Puliti, 2010; Miles, 2008; MogulRotman, 2008).

1.2.21 Standing facilitates the formation of the hip joint in early development



Perhaps surprisingly, the maintenance of hip integrity as a benefit of standing has very little research evidence to support it. Paleg’s 2008 review identified only 3 studies looking at the improvement of hip integrity or the prevention of hip subluxation and dislocation. All of these studies showed improvement or maintenance of hip integrity. Pope (2007) notes that the incidence of congenitally dislocated hips in children with CP is the same as the general population, yet over time, hip dislocation in children with CP becomes a common problem which results in contractures, skin breakdown, difficulties with personal hygiene and other orthopaedic complications (Hagglund, 2009).

Hagglund also suggests that perhaps protection of hips may be possible. Children who stand at the normal developmental age of 12-16 months are considered more likely to form the femoral head and acetabulum (ball and socket) of the hip joint (Labandz, 2011 & 2010; Dobrich, 2010; Rosen, 2010; Silberstein, 2008). In addition, a landmark consensus statement on 24 hour postural management recommended that the most severely affected children should be introduced to standing programmes at 12 months of age (Gericke et al, 2006), while Miles (2010) argues that standing from an early age maintains flexibility, and functional ability to stand and transfer.

1.2.22 Standing enables kids to interact eye-to-eye with their peers



While no formal research exists specifically on this subject, almost every single clinical commentary written about standing cites the eye-to-eye interaction achievable as a major psychological benefit to those who stand because of the social interaction, communication and educational opportunities it presents (Wechsler, 2011 & 2009; Puliti, 2010; Labandz,

2010; Krueger & Coleman, 2010; Rosen, 2010; Thompson, 2009; Silberstein, 2008; Young, 2008; Meyer, 2008; Miles, 2008). Labandz (2011) and Watanabe (2010) expand further arguing that supported standing can eliminate the fear of falling, allowing the individual to direct their attention towards learning and social interaction. Miles (2010) points out that the child

with physical disabilities is able to accomplish tasks in the same manner as typical students. In turn, this eye-to-eye interaction is reported to improve confidence, self-esteem and self image (Hohman, 2011; Kreuger, 2010; Rosen, 2010; Thompson, 2009; Wechsler, 2009; Meyer, 2008; Otzel et al, 2008).

1.2.23 Standing improves skin integrity by relieving pressure encountered during sitting



When individuals sit for lengthy periods of time, the sitting bones (ischial tuberosities) and other bony areas like the bottom of the spine (sacrum) can become vulnerable to pressure and potential skin breakdown. It has already been established that standing improves breathing and circulation, so it seems logical that in the standing posture, oxygenated blood can more easily reach the tissues that are usually subject to pressure. Paleg's

2008 review identified 4 research studies published from 1998 – 2001 which showed that up to 19% of participants with spinal cord injuries reported fewer bedsores and improved skin integrity. However, numerous clinical commentaries provide anecdotal evidence that standing helps to prevent painful and debilitating pressure ulcers because of improvements in circulation (Labandz, 2011 & 2010; Wechsler, 2011; Dobrich, 2010; Puliti, 2010; Miles, 2008; MogulRotman, 2008).

1.2.24 Standing improves wellbeing, alertness and sleep patterns



It is almost impossible to separate one psychological benefit of standing from another as they are so closely related. However, Paleg's systematic review (2008) identified 5 research articles published from 1999 – 2002 which report an increase in

alertness, feelings of well-being, improved quality of life, sleep, and a decrease in fatigue. Clinical commentaries by Labandz (2011), Dobrich (2010), Miles (2010) Smith (2010) and Krueger & Coleman (2010) all report improvements in levels of arousal (alertness). Smith (2010) and Krueger & Coleman (2010) add that in standing, the effects of retained primitive reflexes such as symmetrical tonic neck reflex (STNR) and tonic labyrinthine reflex (TLR) are more controlled, therefore sensory organisation, comfort, energy and attention are maximized. Hicks (2008) advocates a secondary benefit of standing is better quality sleeping patterns.



2. All about Standing frames

2.1 Paediatric Stander

Also known as a standing frame, standing aid or standing system, a paediatric stander assists children who are unable to stand on their own to participate in this vitally important activity. Because standing is crucial to proper physical and mental function, these innovative standing aids can be of great benefit to children with disabilities, developmental delays and other mobility challenges.

While there are a number of different design types, paediatric standers are offered in three basic formats; passive, active and mobile. Passive standers are constructed to stay in one place. Although they may include caster wheels so that caregivers can move the child in the stander, passive standers do not offer self-propulsion to the young user. Active standers are constructed to allow reciprocal movement of the arms and legs while remaining in a standing position. Mobile standers may include powered

mobility to help children to move the stander as they walk and move, or this type may be self-propelled as long as the young user has enough strength, typically what it would take to push a manual wheelchair.

2.1.1 Who uses Standing frame ?

Paediatric Standers, Standing Frames and stand systems are utilised for children with developmental delays, disabilities and other physical challenges. Children such as those with **Cerebral Palsy**, who are confined to wheelchairs or have compromised ambulation skills benefit significantly from standing devices. Standing technologies generally enable individuals by facilitating their ability to stand upright at various intervals throughout the day.

3. All about Cerebral palsy

3.1 What is Cerebral Palsy?

Cerebral palsy isn't one condition. Rather, the term describes a wide range of disorders and developmental disabilities that can arise from damage to a child's developing brain before, during or shortly after birth. The damage occurs in a region of the brain

that controls muscle functions. Therefore, people with cerebral palsy might have problems with:

- Motor skills (control of muscle movement)
- Muscle tone (abnormally stiff or loose muscles)
- Muscle weakness
- Reflexes
- Balance



Some people with cerebral palsy experience cognitive difficulties because the damage has affected multiple areas of the brain. Muscle-tone and motor-skill impairments can also affect cognitive development. If a child has trouble moving independently, it might be difficult to participate in some of the typical childhood activities that foster learning. The brain damage that causes cerebral palsy is permanent and nonprogressive. In other words, it can't be repaired, but it doesn't get worse. Abnormal tone or motor control can shorten muscles and deform bones, however, affecting the normal growth process. People who have cerebral palsy might find that resulting difficulties increase or evolve as they grow older. Such deterioration is more common when people don't receive appropriate health care.

3.1.1 Risk Factors

Children are more likely to develop cerebral palsy when any of the following circumstances is present:

- Bleeding in the brain
- Illnesses that cause an infant to go into shock

- Infections of the central nervous system (such as meningitis or encephalitis)
- Interruptions in oxygen supply or blood flow to the brain
- Maternal infections (chorioamnionitis)
- Physical trauma or injury
- Poisoning from drugs or other toxic substances
- Premature birth
- Seizures Although cerebral palsy isn't inherited, some genetic disorders can cause brain damage early in life. Such damage, in turn, can lead to cerebral palsy. In addition, research is uncovering genetic components to diseases that mimic the effects of cerebral palsy.

3.1.2 About Muscle Tone

Signals from the brain and spinal cord work together to produce appropriate muscle tone (the amount of strength and flexibility a muscle has). Sometimes the brain signals muscles to be stiff; at other times, it shuts off such signals, allowing muscles to become



loose. When the signals work properly, muscles have enough tone to maintain posture and enough flexibility to perform quick, smooth movements. When people have cerebral palsy, however, proper messages from the brain don't reach the muscles. High muscle tone (spasticity or hypertonia) causes muscles that are overly tight or stiff. Low muscle tone (hypotonia) results in abnormally loose muscles and floppy body movements. Some people have mixed tone — some parts of their bodies have high tone, and other parts have low tone — or tone that fluctuates. Although one type of tone abnormality might be obvious during infancy, other tone problems might appear as a child's nervous system develops. A change in muscle tone, however, doesn't mean that a person's cerebral palsy is getting worse.

3.1.3 Affected Areas of the Brain

The kinds of abnormal muscle tone and movement problems that a person with cerebral palsy experiences depend upon which area of the brain is injured.

The brain's motor cortex (highlighted in the illustrations on this page) controls muscle movements throughout the body. As shown in the illustration above, specific sections of the motor cortex control movements in specific parts of the body. So, if damage occurs within the motor cortex, the location of the damage determines what functions are affected.

3.2 Types Of Cerebral Palsy

Doctors classify cerebral palsy into several types, based on the location and extent of brain damage, the body parts affected, and the kinds of tone and movement difficulties present.

3.2.1 Spastic

Injuries to the cerebral cortex can result in spastic cerebral palsy, which causes abnormally stiff muscles. This condition — the most common type of cerebral palsy — can also cause bone deformities and shortened muscles (contractures). Spastic cerebral palsy is divided into further classifications, depending on which limbs are affected:

- Diplegia affects the legs (typically both) more than the arms. It's most common in premature babies.
- Hemiplegia affects one side of the body. It's most common in babies who have strokes or traumatic brain injuries.
- Quadriplegia affects all four limbs. It's most common in babies who experience an interruption in oxygen supply.
- Monoplegia affects one limb.

- Triplegia affects three limbs.

3.2.2 Athetoid

Injuries to the basal ganglia can result in athetoid cerebral palsy, which causes involuntary muscle movements. The movements often interfere with speaking, feeding, grasping, walking and other skills requiring coordination.

3.2.3 Dystonia

Injuries to the basal ganglia also can result in dystonia, which causes fluctuating muscle tone. Although tone is sometimes low, it increases when a person attempts to move or experiences heightened emotions.

3.2.4 Ataxic

Injuries to the cerebellum can result in ataxic cerebral palsy, which causes poor coordination. That, in turn, affects balance, posture and controlled movements. Ataxic cerebral palsy can cause unsteadiness when walking and difficulties with motor tasks.

3.2.5 Mixed

Injuries to multiple brain areas — usually the cerebral cortex and basal ganglia — can result in more than one kind of abnormal muscle tone. For example, someone could have spasticity and dystonia, or dystonia and rigidity. By identifying what type(s) of cerebral palsy a child has, doctors and therapists can recommend treatments. They also can give caregivers a better idea of what the child's future might hold. Some potential problems can be prevented or corrected if addressed early in a child's life.

3.3 Choosing the correct stander

Static standing frames are available in three configurations (although some are designed to move between all three configurations):

- Supine standers
- Prone standers
- Upright standers

3.3.1 Supine standers



Supine standers are those in which the child or young person is lifted or hoisted into lying on their backs. The stander is then adjusted to an appropriately more upright posture, depending on the individual's ability. Supine standers are best for those who lack antigravity strength in the upper trunk and neck (Labandz, 2011). They can also provide a useful change of posture for those with significant hip and knee contractures. While the full posterior support is useful for those with poor head and trunk control, the backward tilt affects the user's angle

of vision, and impacts on social interaction and participation in functional tasks (Dobrich, 2010). Depending too, on the angle of tilt, the amount of weight bearing may be reduced (Wechsler, 2009).

3.1.2 Prone standers



Prone standers are those in which the child or young person is tilted slightly forward. Prone standers provide anterior support requiring adequate head control in the first instance. However this posture is used to encourage head control, strengthen the upper trunk and shoulder girdle (Dobrich, 2010), and inhibit

extensor tone (Labandz, 2011). The further the angle from upright, the less the weight bearing advantages of standing.

3.3.3 Upright standers



Upright standers are designed to replicate the natural standing posture as far as possible. At this fully upright angle, weight-bearing forces are directed more typically through the spine, legs and feet achieving the maximum possible weight bearing advantages. Regardless of the stander style, the most important element is the achievement of desirable postural alignment. (Labandz, 2011).

3.3.4 Standing and every day activities (function)

It can be seen that each physiological benefit of standing is closely related to another, and in turn these benefits provide a wide range of psychological benefits. However, in turn again, these benefits can combine to improve an individual's ability to carry out every day activities (function). Paleg's 2008 review identified 3 research articles which report standing helped individuals with daily home activities and self-care activities. In addition, the review identifies research which indicates improved shoulder and arm positioning, hand function and reaching. Clinical commentary also endorses standing for improved head, trunk and upper extremity control (Smith, 2010); improved functional reach (Thompson, 2009); ability to perform fine motor tasks, hence improving enjoyment and social interaction (Labandz, 2011); improved ability to work as independently as possible (Puliti, 2010); increased play, physical education opportunities, even dancing (Miles, 2010; Labandz, 2010, Wechsler, 2009); and improved ability to participate in transfers and independent dressing, resulting in self-empowerment when coping with a disease (Young, 2008).

3.3.5 What is the best angle for standing?

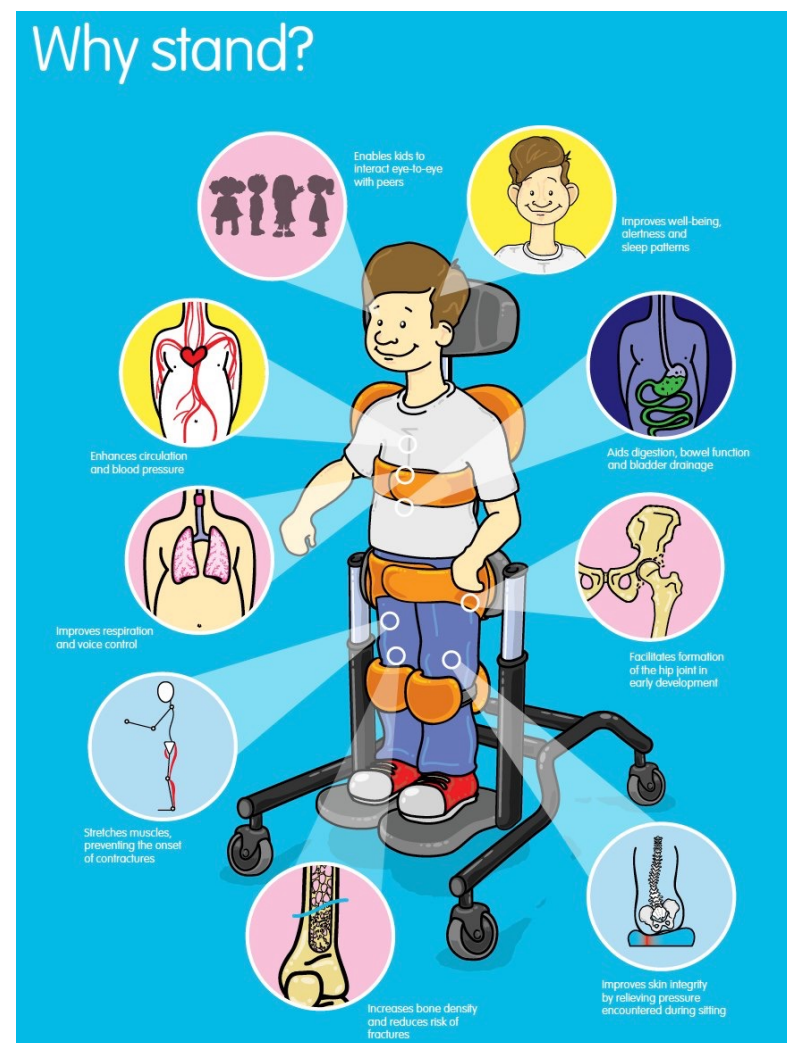
Clearly, the more upright a person can tolerate standing, the greater the load bearing through the feet and therefore the greater the impact of the benefits of standing, in particular on bone mineralisation. A research study by Herman et al (2008) found that, in a group of 19 participants with spastic quadriplegic CP, on average 68% of body weight was transferred through the feet. There was a strong correlation between the inclination of the stander and the percentage body weight transferred and there were often large differences between right and left weight-bearing measures in the same person, perhaps as a result of left/right asymmetries. In addition, it was found that trays, straps and supports reduced the amount of weight through the feet. However what remains inconclusive is how much weight "is enough" to improve bone density. Therefore the more upright the better, remembering that for some, the upright posture is just too much (Wechsler, 2009).

3.3.6 How long should someone stand in order to gain these benefits?

Unfortunately this is a really difficult question to give a clearly defined answer to. Paleg grouped together the research studies in her systematic review by duration of standing, and found that they range from 12 minutes on average per day to two hours five days a week. However, by far the most common occurrence is 30 – 60 minutes daily. Clinical experts such as Rosen (2010) advocate 45 minutes to two hours daily, while Paleg, quoted by Silberstein (2008) recommends seven to 10 hours per week if the goal is to increase bone density.

It appears that the duration of standing is dependent on the person's age, diagnosis, tolerance of the standing posture, and benefit of standing sought (Rosen, 2010). It also seems likely from recent clinical expert opinion that several shorter periods of standing may be more beneficial than one prolonged period (Wechsler, 2011 & 2009; Silberstein, 2008). An appropriate individual standing programme should be always be implemented by a qualified physiotherapist.

3.3.7 Benefits of using standing frames



Standing frames may have several physical and/or psychological benefits for you, including:

- To get some weight bearing for healthy bones (maintaining bone density)
- For stretching leg muscles to prevent them becoming tight over time
- Reduction of spasticity to improve functional transfers and mobility
- organs and systems by enabling them to function more naturally - e.g. bowel and bladder function, respiratory system; improved digestion and circulation
- Improved posture
- Prevention or improvement of lower limb contractures by improving range of motion and joint flexibility
- Prevention of pressure ulcers caused by prolonged sitting,
- Preventing muscle wasting
- Increases self-confidence, self esteem, self-image and overall quality of life

3.3.8 Doctors, Physiotherapists, orthopedicians, Professors, Paediatricians and Neurologists met for the project.

Doctors	Physiotherapists	Professors	Hospitals, Colleges and Educational Institutes
Dr.Gagan Preeg	Dr.Sudha - IIT - Bombay	Prof.P.Kumaresan	Mahathma Gandhi hospital and research Institute - Pondicherry
Dr.Pandiyan	Dr.Snehal Deshpande - Hiranandani	Prof. GG ray	Christian Medical College - Vellore
Dr.Renuka Devi	Dr.Kalashree - Hiranandani		Stanley Medical College - Chennai
Dr.Natarajan	Dr.Lakshmi Praba - KEM	Dr.Suresh - CMC	Government Hospital - Cuddalore
Dr.Prateesh - Mahatma	Dr.Archana - KEM	Dr.Mohandas Gurup - Anna	Government Hospital - Pondicherry
Dr.Natesan - Mahatma	Dr.Iyer - KEM	Dr.Sundaraganesh - Raja Muthaiya med. College	Annamalai University - Chidambaram
Dr.Nallam	Dr.Sheela - Indra Gandhi	Dr.Ramesh Kumar - JIPMER	Raja Muthaiya Medical College - Chidambaram
Dr.Younis	Dr.Anitha - AIIPMR	Dr.Priya Jose - PIMS	Indra Gandhi Hospital - Pondicherry
	Dr.Smitha - AIIPMR		JIPMER-Pondicherry
	Dr.Cini - IIT - Bombay		PIMS - Pondicherry
Dr.Chandrasekar			KEM - Mumbai
Dr.Baskaran			All India Institute of PMR - Mumbai
Dr.Bhuvanesh			
Dr.Prabakaran			
Dr.Vignesh Hari			
Dr.Lemiya			
Dr.Poorvi			

3.3.9 Discussions with Doctors, Physiotherapists, orthopedicians, Professors, Paediatricians and Neurologists.

Discussions include not only just about cerebral palsy, standers and standing frames but also about

- Recognising cerebral palsy.
- How can we help them with their daily activities.
- What the child can and cannot do.
- Range of motions exercises.
- Developing their early skills.
- Prevention.
- Taking care of them.
- Their development.
- Their behaviour and intelligence.
- How is it being treated.
- How their limbs work and its anatomy.
- The process of standing.
- And also helping the child to achieve better positions.

The doctors said that just the standers are the equipments that were used in the 90s, Nowadays the patients have to do some activities while they're using the standing frame. The standers should have an activity board to keep them busy at all the time.

They said that just standing is not much of use. If there is a possibility of having features that allow the patients to sit and stand and try to walk, that would be an innovative solution. But it all depends on the age and condition of the patient.

A normal child would stand at about 12 months old. In the case of a child with cerebral palsy, the earlier we start giving treatments and therapies the better their development will be. So the appropriate age for starting to use the stander is about 16-18 months old.

One of the main criteria of the stander is that it should be very inexpensive. The reason for that being the standers that are currently available are very expensive and they cost about \$2000 - \$3000. And the fact that there are no companies that manufacture standers in India, these standers have to be imported specifically for each patient.

The stander should be adjustable vertically and horizontally meaning that it should be suitable for all the different size of children having in mind the fact that children grow faster than



EasyStand Bantam Stander Small

Download Order Form to Customize

From: \$1,943.94

Free Shipping!



KidWalk I Dynamic Mobility System

For Ages 1-7 years

From: \$2,422.26

Free Shipping!



EasyStand Original Evolv Sit To Stand Standing Frame

Choose Size

From: \$2,603.76

Free Shipping!



Symmetry Stander

Choose Size, Color, and Pump Handle

From: \$2,467.80

Free Shipping!

The Symmetry Stander is a solid seat standing system with a padded seat and an optional low or high back for extra support and comfort. The standing frame is easy to transfer into



Superstand Standing Frame

From: \$2,223.86

Free Shipping!

The Superstand Standing Frame provides the benefits of standing or positioning for users who cannot stand on their own and have specific



Rifton Supine Stander

Offered in two sizes for a wide range of users

From: \$2,475.00

Free Shipping!



Medium Rifton Mobile Stander

From: \$2,250.00

Free Shipping!

The Rifton Medium Mobile Stander allows for the important social interaction that all children need, including wheelchair users. This wheeled standing frame lets users propel themselves just like they would



Gazelle PS Standing Frame

Choose Size and Accessories

From: \$3,073.50

Free Shipping!

The Gazelle PS Standing Frame is designed to be a prone, supine, and upright stander that fits children ranging from 1 to 14 years of age. Use it to help children whose final standing position



Rifton Mini and Small Mobile Standers

From: \$1,660.00

Free Shipping!

The Rifton Mini and Small Mobile



Custom Leckey Squiggles Stander

Create Your Own Stander

From: \$1,504.90

The Custom Leckey Squiggles Stander provides a stander that allows for full customization to suit the specific needs of each individual user. Fully adjustable, this stander can be used for upright, supine, or prone positioning. The adjustable supports include a pelvic support, a sternum pad, a headrest cushion, knee supports, and a footplate. Optional accessories such as headrest laterals and sandals for the footplate allow additional stability when needed. Standing in the Custom Leckey



Rifton Prone Stander

Choose Size

From: \$1,825.00

Free Shipping!



Upright Stander

Choose Model

From: \$849.77

The Upright Stander is an upright standing frame designed by therapists for children who need support in the form of mid-line positioning. This pediatric stander allows the user to experience weight bearing and full use of their arms and upper body, while

adults.

One of the main concern of the available standers is that it looks like a medical device. the problem with that is that the children are getting scared when the physiotherapists try to make them stand in the standing frame. They said that it should look more like a child toy rather than a medical device.

Incase of a mobile stander, the stander should be of appropriate weight since it should be moved around by the child or the parent or whoever is trying to move the equipment. The stander should also be portable and should be easily storable.

The stander should have modular parts for specific use. for example if the child wants to use a harness for its hips or chest instead of buttocks, there should be a facility to do that.

4. Product study

4.1 Existing products

The existing products can be categorised into two categories, expensive and feature rich ones and inexpensive and static ones. The following are the product example of some of the existing

products both expensive and inexpensive ones and their features.

4.1.1 Expensive models



Above are two of the examples for expensive models with abundant features. They typically come with full automation. For example all the postural changes can be controlled by switch pad through hydraulics. They usually have more than two postures for standing. The height and wight heights are adjustable The standing angle is adjustable. They are usually made of metals specifically steel and are usually heavy because of that. Though

they are supposed to be used at one place, they can be easily moved from one place to another thanks to the mobility features.

4.1.2 Inexpensive Models



Above are two of the examples for Inexpensive models. They usually have almost half of the features from the expensive models. Even these inexpensive models cost about \$1000 easily. Some models have single hydraulic pistons for postural changes and these usually support single postures. Similar to the other

expensive models they have mobility features. Features such as automation, adjustability are absent.



4.1.3 The cheapest models

Besides the expensive and inexpensive models, there is a category that are very cheap and some of them are suitable for Indian rural places. They usually are made of wood and finished with wooden fixtures. This is the category I'm going to design for.

These are some of the examples of the cheapest models available in the market right now. These are usually made of wood and are finished with wooden fixtures. And they usually have one single



posture. These do not have any kind of electrical features or automations whatsoever. These are made to do the job. They usually are made with minimal materials and cheap materials like wood that can be seen in the images above. They come in same size and are usually the same exact size that cannot be changed or modified as the child grows. If the size seems not fit, the user has to get a new one of their new size. Similar to the same size they usually are not adjustable since the adjustability demands more moving parts and moving parts increase the price of the equipment.

Some doesn't even have cushions and harnessing features. These doesn't have headrests or armrests subsequently reducing the overall cost of the product. They are usually easy to manufacture

since they do not have much of a materials or even variety of materials. Since mass manufacturing is easy compared to the expensive where every single part has to be manufactured and assembled.

4.1.4 Picking up from here

Here is where our product come into picture. There is little known segment where the products have all the features and are considerably cheap compared to the models that are available in the market right now. Picking up from here and moving towards the segment that is cheap and has all the basic necessary features would be the right direction for the project.

5. Product examples

5.1 Example 1

LECKEY°

Squiggles
Stander



About Leckey

Established in 1983, Leckey is a globally recognised pioneer in the research and development of products that help adults and children with disabilities to go, do, enjoy and participate in everyday activities throughout the day and night.

Leckey take a highly clinical approach to product design and development. Through in-depth clinical research studies with leading universities, and extensive trials with occupational therapists, physiotherapists, users and their families, Leckey continue to develop posturally supportive, family friendly products for all day care, at every stage of life.

Through early intervention, childhood and adulthood Leckey's experienced team of designers, therapists and bioengineers work together to develop products that meet the clinical needs of the healthcare professionals and the social needs of the user.

To achieve this, Leckey works with the healthcare professionals, the individuals and carers who use our products everyday. With their help, we create the dependable, durable, proven and high performance products that we are known for worldwide.

5.1.1 Squiggles Stander

The Squiggles Stander is an extremely versatile three-in-one stander, offering prone, upright and supine standing in one product.

The product has a large growth range for kids aged 1 - 5 years and is available with a range of indoor and outdoor mobile bases.

The wide range of adjustability offered by the chest, hip, and knee supports and the head support in Supine provides clinicians with the tools to position a large range of children in the same product.

Colourful, tactile and fun design is ideal for young kids, with attractive age appropriate, machine washable covers, available in four colours.

Lightweight and robust stander support frame can be easily transferred from one chassis to another or disassembled for storage or transportation.

- The height, depth, width and angle of the cushioned pelvic positioning support can be changed to support the child comfortably in a secure position.



- The height, depth, width and angle of the chest positioning support can also be adjusted.
- Cushioned sternum pad offers extra support which encourages extension and gives a wide range of freedom for the arms thus allowing a greater range of activities.
- Headrest is compatible with a variety of head supports, including Whitmyer and Otto Bock. It can be removed for prone standing.
- Adjustable footplates and sandals giving positive foot placement. The sandals can be turned around for prone standing.
- Cushioned knee supports, which are individually adjustable in height, angle, rotation and depth, support the child's knees when supine standing.
- Activity tray can be used in either prone or supine position.
- Pivot chassis with its 4 lockable swivel castors is easy to manoeuvre and can be tilted from vertical to almost horizontal.



- Compact, static Easel chassis offers angle adjustment from vertical to 70°.

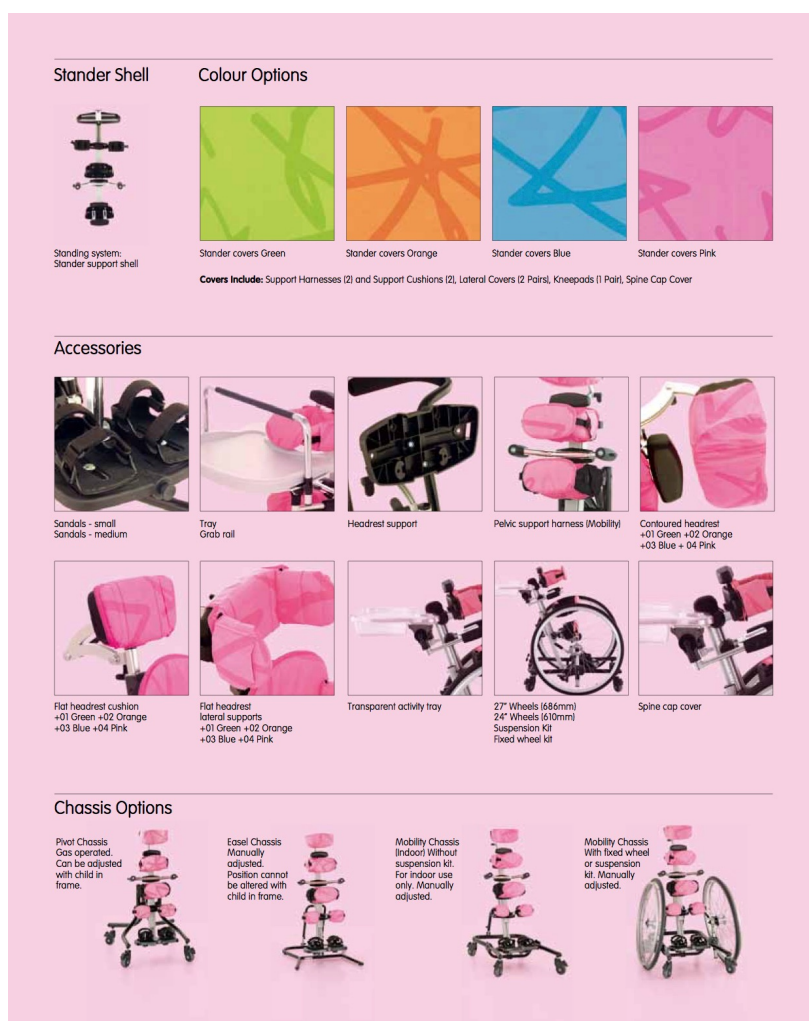
The combination of the standing support and chassis options including our outdoor mobile chassis means that kids can benefit from standing therapy in any environment.

The Squiggles Pivot chassis offers a wide range of tilt incline options adjusting from vertical to almost horizontal.

This enables your child to be placed in the system at their preferred angle. It has 4 lockable swivel castors which make it very manoeuvrable around the classroom or home. This lightweight chassis can fold away in seconds for storage or transportation.

The Squiggles Easel chassis is a compact static chassis which offers angle adjustment from vertical to 70°. The Easel chassis is a static base which is extremely compact and folds away easily for storage.

The Squiggles Mobility Chassis encourages children to explore their environment whilst maintaining their required posture. The mobility chassis offers a choice of 610mm (24") or 686mm (27") quick release wheels with a depth adjustable hand rail and drum locking brakes.





5.2 Example 2

Leckey

Leckey works with individuals, therapists and carers to design products with both a clinical and an emotional focus. Using the latest research and clinical understanding, Leckey creates practical solutions which are easily integrated into family life, life is about going, enjoying, participating and doing.

Leckey understands the importance of standing therapy and the benefits that it can bring a child, and we understand that for some children, standing therapy is more difficult to achieve due to the postural challenges they face.

That's why Leckey developed the Mygo Stander to bring standing therapy to children aged 4 to 14 years old. As a child grows out of the popular Squiggles Stander, their standing therapy can continue with the Mygo Stander as it encourages a natural standing posture with improved function.

A three-in-one Supine, Prone and Upright stander with continuous angle adjustment from vertical to 10 degrees from horizontal.

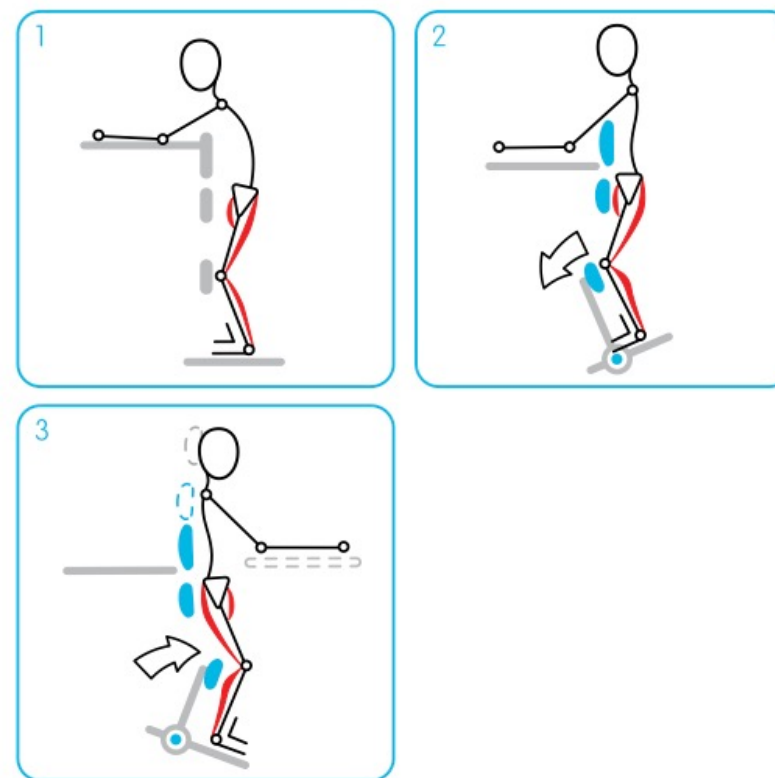
Not only does the angle of the stander change from prone to supine, the angle of the knee and foot supports relative to the hip and chest supports can also be adjusted by 20 degrees to accommodate contractures.

Comfort covers, belts and harnesses, machine washable at 40°C are available in orange, blue and pink.

Infection control belts and harnesses, which are machine washable at 90°C, combined with wipe clean PU supports give a fourth option.

Accommodation of fixed hip and knee contractures

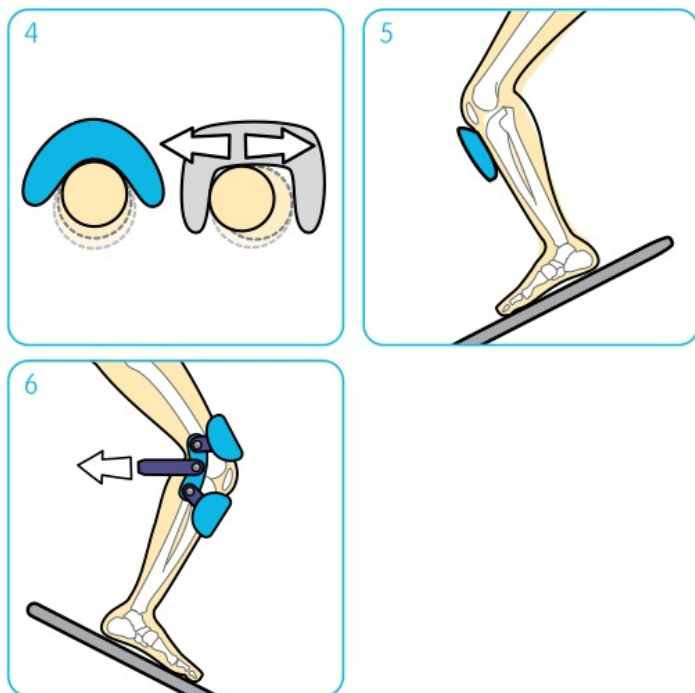
During extensive clinical trials, we have observed a number of children with kyphotic postures and posterior pelvic tilt during their standing therapy, often as a result of a stretch on the hamstring muscles. The novel swinging footplate on the Leckey Mygo Stander mechanically links the movement of the footplate to the movement of the knee support. This allows the user to stand in a fully supported position with hip and knees extended thereby taking the strain off the hamstrings and other contracted muscles. The result is a more upright natural posture combined with an ability to support users whose contractures previously made them unsuitable for standing.



Reduced load bearing on the patella

The innovative V-shaped design of the knee supports on the Leckey Mygo Stander ensures a proximal irrespective of the size of the child's knees and maximises the surface area of loading. This load is optimally distributed on the proximal tibia and is directed away from the patella in prone. In supine the unique

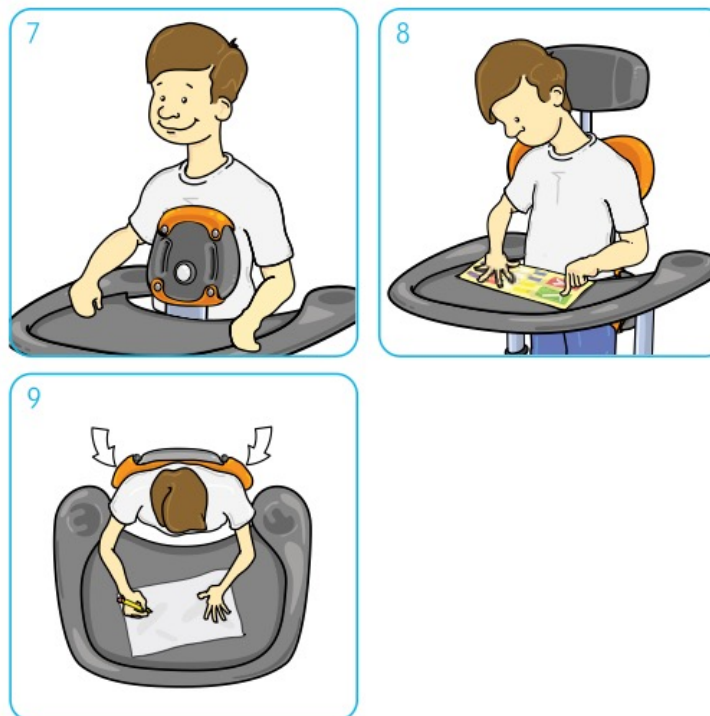
split- strap design (optional) self locates around the patella and self aligns for any knee angle, thereby equalising pressure above and below the patella.



Improved function

The ergonomically designed chest pad replicates the shape of the rib cage allowing the shoulder girdle to freely protract and

retract in prone standing. Combined with a lower tray height and more upright head and chest position, the client's upper limb function is significantly improved. The supine shoulder support also stabilises the shoulder girdle. Consequently the Leckey Mygo Stander increases the ability of the user to play, feed and communicate.



Accommodates children with a larger build

Some children have a larger build due to low tone and restricted mobility. The innovative design of the knee and foot supports means that these supports do not have to be positioned directly in line with the chest and hip supports. They can be placed slightly away from this line, allowing the Mygo Stander to accommodate larger children in prone.

- The ergonomically designed chest pad replicates the shape of the rib cage allowing the shoulder girdle to freely protract and retract in prone standing, improving upper body function.
- Breathable, machine washable, colourful covers over the wipe clean PU supports.
- The pelvic de-rotation belt enables the therapist to position the client's pelvis in a central and neutral position with minimum effort. A gluteal prompt provides a proprioceptive sense of security to the client.
- Flexible hip laterals provide proximal support to the pelvis and ensure the user remains in a central position.

Prone Configuration



- The height adjustable knee supports are available with a range of tibia straps. Their V-shaped design ensures a wide range of knee shapes and sizes can be accommodated in comfort while distributing the pressure.
- Optional sandals can be positioned on the footplates to individually accommodate a range of foot positions. Sandal raisers are available to adjust for leg length discrepancy if required. The medial/lateral and anterior/posterior positioning of the sandals can be individually adjusted.
- The adjustable footplates with non-slip surface are linked to and move with the knee supports, which maintains the angle between the feet and the knees as the footplates move relative to the hip support. This means that the Leckey Mygo Stander can be used by children with AFOs. The footplates can also be adjusted individually to accommodate up to 10° plantar exion or dorsi exion.
- Lockable castors make the lightweight chassis easy to manoeuvre around the therapy room, school or home environment.
- The tool free adjustments are easy and intuitive.



- The pivot point of the lightweight chassis lies close to the client's centre of gravity allowing the frame to be smaller and more mobile around the therapy room, school or home.
- The soft PU hip pad is height adjustable.
- The soft PU tray with interchangeable inserts is height and angle adjustable and can be adjusted to a low position with close proximity to the user to encourage upper limb movement.
- The optional posterior support pad gives the child the maximum feeling of security and support when standing in prone. It includes a pommel and hip laterals.
- Wraparound flexible chest laterals support the upper body in either prone, upright or supine standing with minimum obstruction.
- The pelvic de-rotation belt enables the therapist to position the client's pelvis in a central and neutral position with minimum effort. A gluteal prompt provides a proprioceptive sense of security to the client.
- The height adjustable supine knee supports are attached using a buckle mechanism and have split straps which self align above and below the patella. Basic knee straps can also be used in supine.

Supine Configuration



- The wings on the contoured shoulder support can be angle adjusted to provide shoulder protraction. This brings the hands to midline which increases upper limb and hand control for improved function.
- The headrest support bracket is compatible with a range of head supports, including our own custom-designed wide headrest.
- Through the adjustment of the swinging footplate, plantar exion/ doris exion and depth adjustment of the PU knee supports, the Mygo Stander can accommodate up to 25° of contractures both in prone and supine.
- The easy-to-read knee and footplate angle indicator allows records to be kept of each child's individual requirements.
- The manual angle adjustment mechanism allows an in nitesimal range of angles from upright to 10° from horizontal. The adjustment is smooth and can be made with the child in the product.
- The easy-to-read stander angle indicator allows standing programmes to be recorded and repeated for each client.

6. Case Studies

6.1 Case 1



Miles is a seven year old boy from Vancouver, Canada, who has Spinal Muscle Atrophy (SMA). SMA is a degenerative condition that causes progressive muscle weakness. Miles was using a custom made, power, sit to stand wheelchair but was having difficulty standing in it comfortably.

Clinical Background

Miles' diagnosis means that he is increasingly losing muscle strength in his core (trunk) muscles and lower limbs. This causes muscle shortening at his hips (hip flexors), knees (hamstrings) and ankles (Achilles tendon). In turn this means that Miles' hips and knees want to stay bent, causing his lumbar spine to overextend (lordosis), and his bottom to stick out, leaving Miles in a crouched posture.

Goals for Standing

- Maintain or improve range of movement at hips, knees and ankles
- Maintain or reduce lumbar lordosis
- Maintain or improve core muscle and lower limb strength
- Improve head control
- Increase opportunities for peer and social interaction

- Increase opportunities for improved academic performance

Considerations for equipment

Miles requires a stander which can accommodate his contractures without compromising his overall posture, and provide him with a standing posture that he can tolerate.

Approach



Miles tested the **Mygo Stander** in school for about a month before his final fitting and provision. The fitting was challenging due to the extent of Miles' knee contractures. The stander was set up in the supine configuration with the posterior support and pommel. Although this accessory is typically used in the prone configuration, this was found to work best for Miles due to

his tendency to crouch. He also benefitted from having the support on which to lean his arms.

The knee cups were rotated 180° which, because they are offset, raised them to the appropriate height.

We were able to move the knee cups forward to provide posterior support while the split knee straps provided perfectly placed anterior support above and below the patella.



Outcome

Although this accessory is typically used in the prone configuration, this was found to work best for Miles due to his tendency to crouch. He also benefitted from having the support on which to lean his arms.

The knee cups were rotated 180° which, because they are offset, raised them to the appropriate height.

We were able to move the knee cups forward to provide posterior support while the split knee straps provided perfectly placed anterior support above and below the patella.

Miles has been using the stander since July 2012 with great success.

Miles, who previously would protest against standing, asked to be placed into the Mygo stander and was happily tolerating standing in the Mygo Stander for at least 15-20 minutes.



6.2 Case 2



Julia is a young woman with Cerebral Palsy Spastic Quadriplegia who enjoys interaction with her peers and getting involved in activities. She has a very supportive family and school staff. Although non-verbal, she is able to communicate “yes” and “no” reliably...and she has a very cheeky personality!

Clinical Background

- Julia’s Horizon Stander supports her 24-hour postural management programme
- Julia is a young woman with Cerebral Palsy Spastic Quadriplegia who enjoys interaction with her peers and getting involved in activities. She has a very supportive family and school staff. Although non-verbal, she is able to communicate “yes” and “no” reliably...and she has a very cheeky personality!
- Julia had outgrown her previous stander
- Gross Motor Function Classification Scale Level V
- Chailey Level 2 supine lying and box sitting
- Learning to drive a power chair (with head array)

- Julia had not been using her stander over the summer – she had developed mild plantar flexion and knee flexion contractures
- Julia has very limited head and trunk control

Goals for Standing

- Allow weight-bearing opportunities
- Provide a change of position from her manual wheelchair
- Provide a prolonged stretch to hip flexors, knee flexors, and plantar flexors Complement existing 24 hour postural management programme



Considerations for equipment



- Only one teacher aide available to transfer Julia into the stander, need to be able to hoist into frame
- Needs to be easily transportable around home and school (unable to be stored in classroom)

Approach

A supine stander was considered able to meet these needs. The Leckey Horizon stander was trialled...and Julia LOVED it!!

Outcome

The Leckey Horizon stander met Julia's needs because:

She can be easily hoisted onto the frame in a supine position

The straps are user friendly meaning one person can manage the transfer. The power tilt mechanism is predictable for Julia, adding to her comfort and security.

The kneeblocks and footplates are easily adjustable – they allowed for Julia's initial contractures, but can be adjusted as the contractures resolve.

Easily manoeuvrable around home and school environments.
Child friendly looking stander, which does not look clinical!

6.3 Case 3

Introduction

Alice is a 13 year old girl who has spina bifida, hydrocephalus and left sided hemiplegic weakness. She has a spinal rod and is PEG fed for fluids.

Alice has significant hip and knee contractures and is currently using a sit-to-stand frame. However, she has a tendency to “hang” in it, and is not very comfortable. As a result Alice's therapists were considering ceasing her standing programme, but it is important to Alice and her family. She may be considered for future hip and knee surgery, so maintaining range of

movement (ROM) will always be an important consideration for Alice.



Clinical Assessment



Good head, neck and shoulder control

Windswept slightly to left as a result of increased tightness in right hip flexors and adductors

Approximately 300 flexion contracture at knees

Approximately 250 flexion contracture at hips

Wears AFOs so ankles positioned at 900

Approach

Alice's hip and knee flexion means she is unable to use a conventional prone or supine stander. Her sit-to-stand frame goes some way to an upright posture, but comfort and functionality is limited.



After determining Alice's range of movement at hips and knees, the Mygo swinging footplate was adjusted to its maximum angle of 200 in the prone direction. The foot sandals were moved backwards to allow greater knee flexion, and the footplates were adjusted to the maximum angle of plantar flexion to maintain an angle of 900 at the ankles.

Outcome

Alice's contractures and slight windsweeping are successfully accommodated in the Mygo stander. The narrow chest support also means that Alice's hand function is not impaired even though she does not have a perfectly symmetrical trunk position. Alice reports finding the standing frame very comfortable; her therapist is delighted because her standing programme can now continue.

6.4 Indian Approach

The Indian approach to the problem is simplest way possible. They are simply used to keep the unstable patient in proper standing position. Two Pieces of fixing Belt support hip and legs. Preventive knees from bending. This type is convenient for observing the condition of lower limb with arm rest. Made up of wood with polished work & metal Frame work.

Some are multi-Position Standers that suitable for special needs child with quadriplegia and paraplegia, in other words a stander that offer multi-position standing aids without any hassle. These Standers are combination of Prone Stander, Supine Stander, Upright Stander and Vertical Stander. These standers are safely support the child in an upright yet mobile position and makes

interaction with their peer easier. An Activity tray on wheels is also provided with the unit.

But having said that they are usually made of heavy plywood and would require more than three person to operate the machine. And they do not have any kinds of cushion at any place whatsoever in most of the standers. They usually come with sharp edges and corners. They activity tray are usually heavy and cumbersome. It needs two persons to operate the single activity tray while another person has to hold the child.



The braces or harnesses are usually like ropes instead of cushioned ones. And most often than not they require quite a large space not just for storing but also while using the device. And most of the stander support only one single posture.

These devices consist of a large, flat base of support with uprights that extend up the back of the legs and torso. The knees, hips and chest are strapped into this frame to support the individual in a standing position when it is not possible for the person to support himself or herself. This is used most often with children who have cerebral palsy than any other disability.

These are usually teakwood and ply board constructed, naturally finished standers that reclines through an arc and can usually not be adjusted to any desired position in most of the standers. In most of the cases it does not come with adjustable foam padded headrest which can be formed & reformed as needed. Has a high back supports & holds the child with a belt rather than a soft cushioned harness. Laminated activity Tray with different size with polished wooden raised edges which holds the items from falling. Adjustable seat & footboard are sometimes not wide enough to suit all the children of different sizes. Mounted on ball bearing castors.

Having said that very rarely there are uniquely designed standers that can provide a variety of standing positioning like

Prone, Supine or Vertical postures. They have padded Knee rest and chest support adjust up or down. Foot boards with adjustable toe & heel loops adjust in or out. Leg abductor pad that adjusts vertically and they have removable pad that is positioned against the buttock for maximum support.

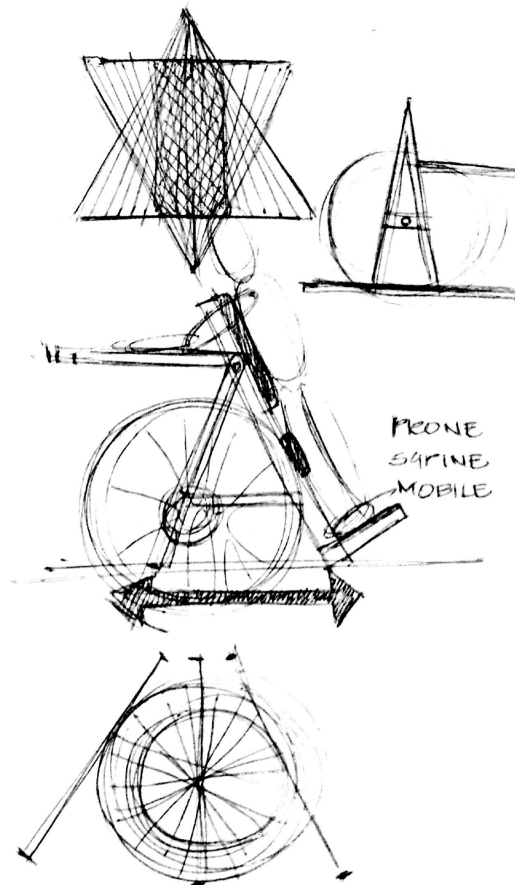
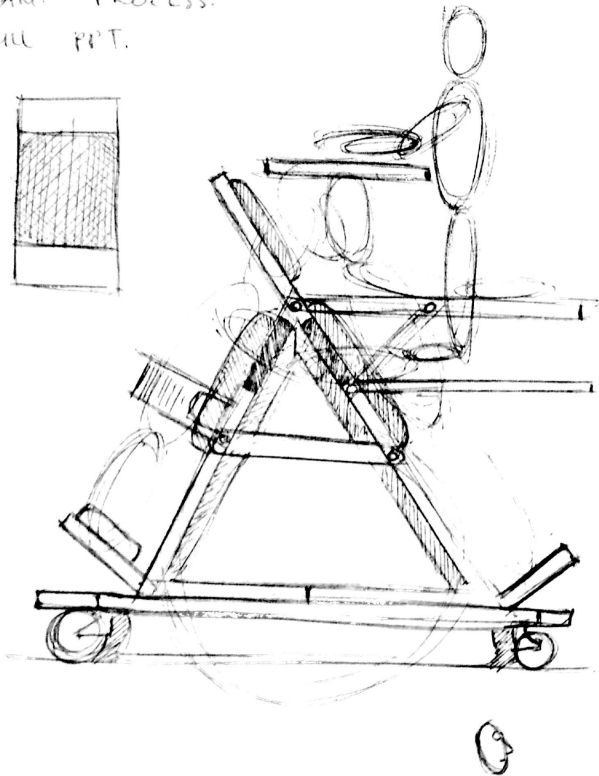




7. Ideations

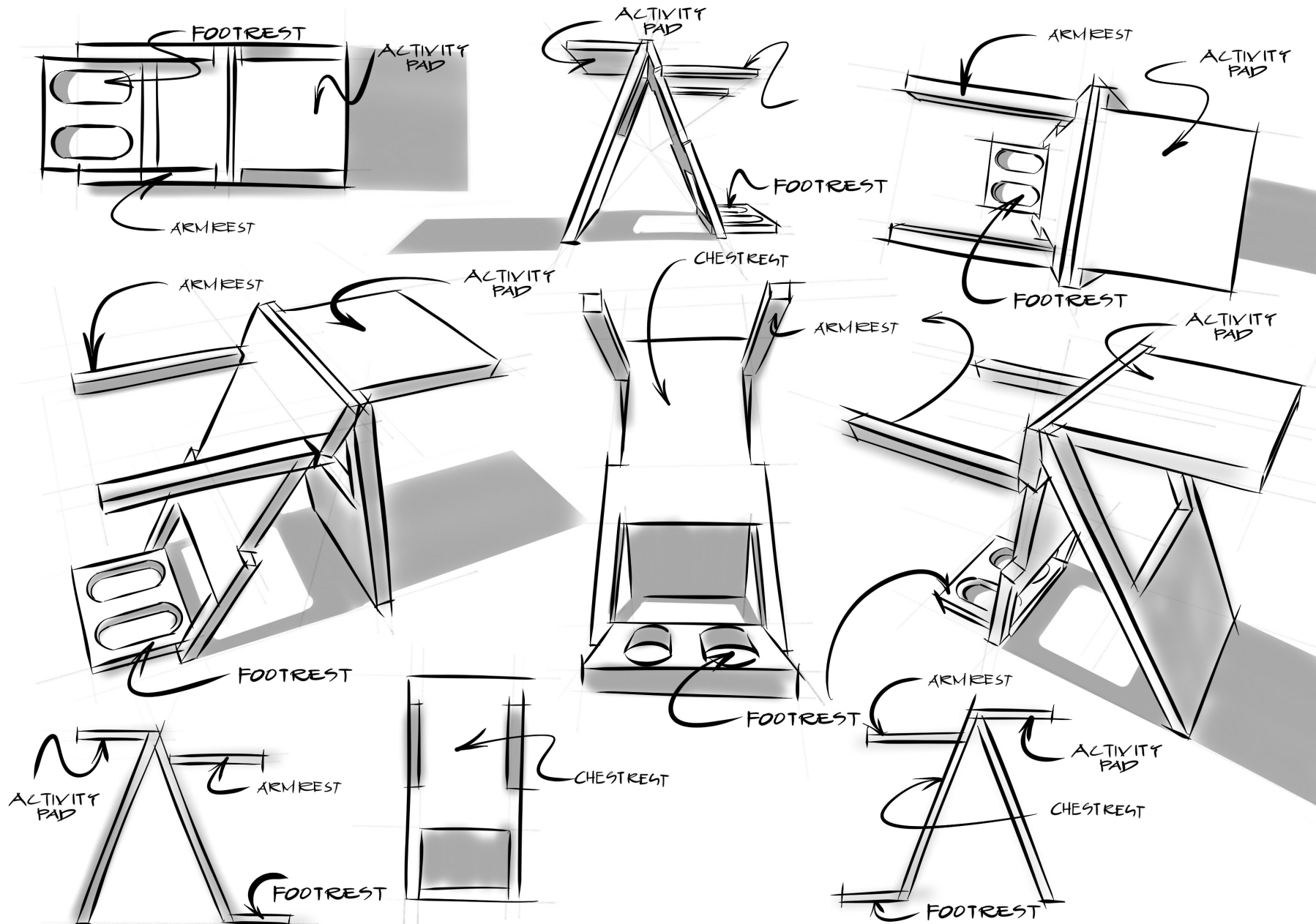
7.1 Concept 1

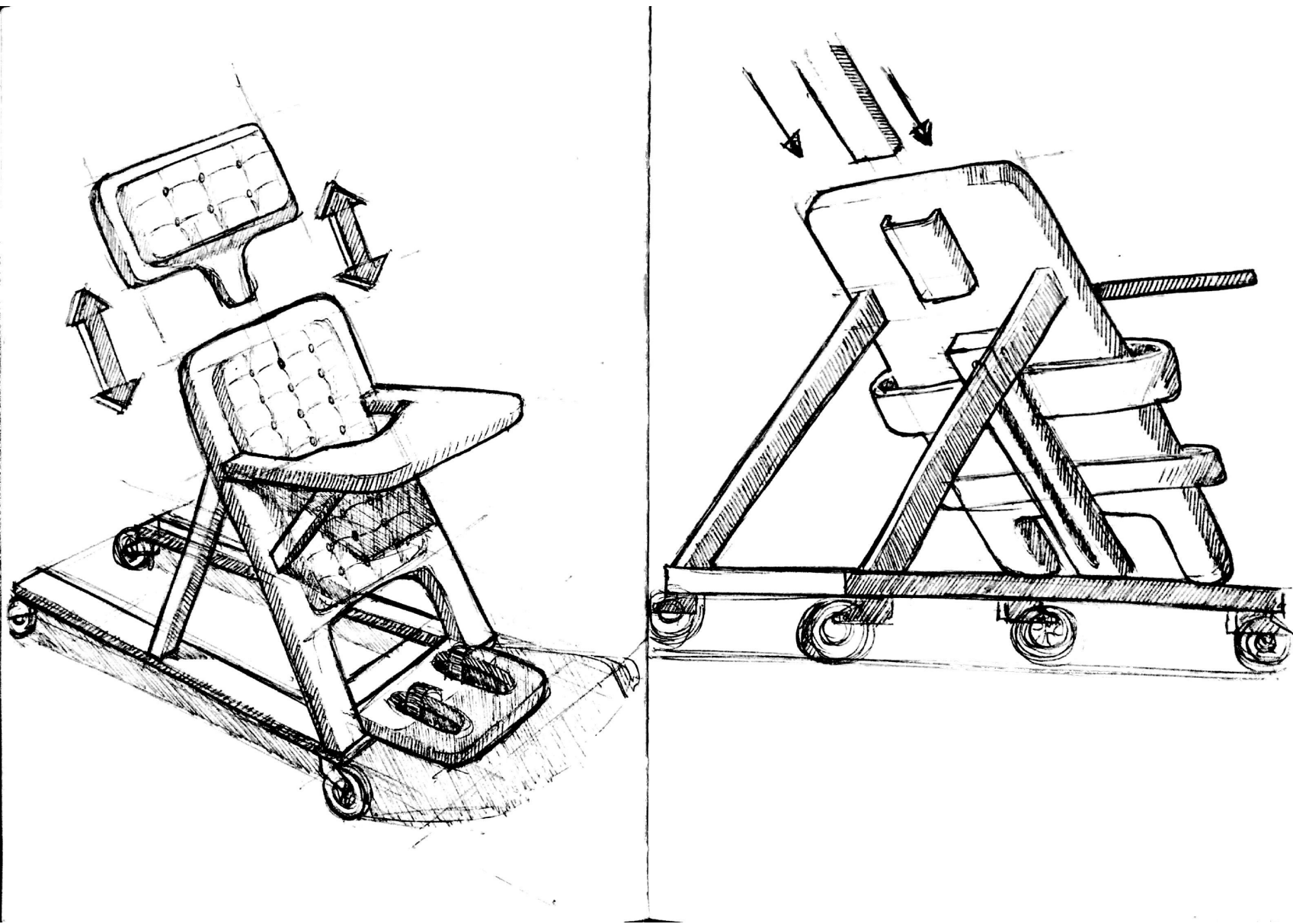
JOINERY DETAILS
MAN. PROCESS.
FALL PPT.

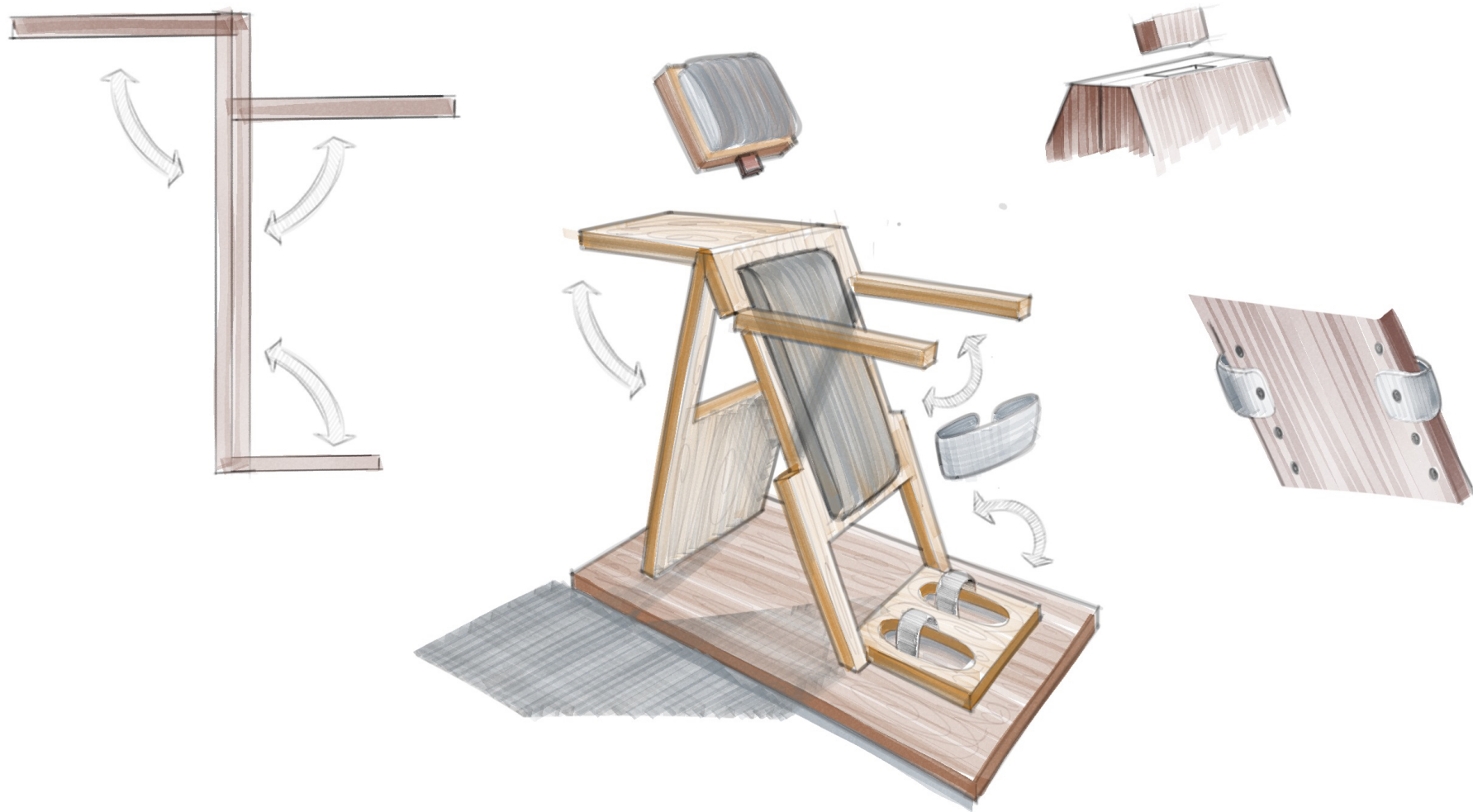


The first concept, the idea was to come up with a stander that could be used for three different standing postures as well as achieving it by using cheap and locally available material such as wood either natural or processed. It also should be easily storable and should be a portable device.

The first concept was a folding concept kind of like a book opened and kept upside down. The arm rests, headrest and the foot pedals can be opened out from the front and back of the stander. The initial idea is that one side of the stander can be used for prone position while the other for supine position. Then the sides of the stander can then be moved close to each other to make it an upright stander.

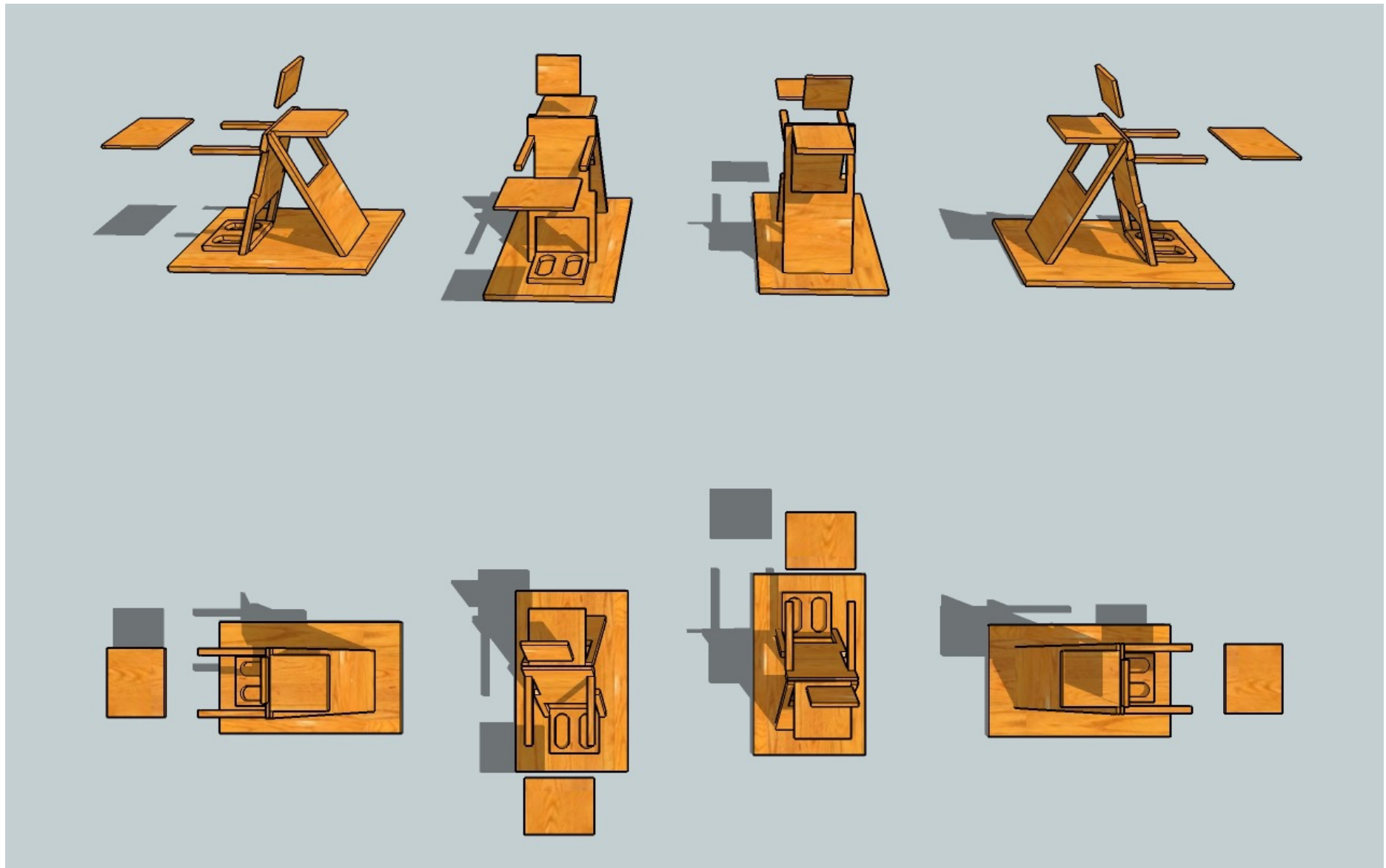


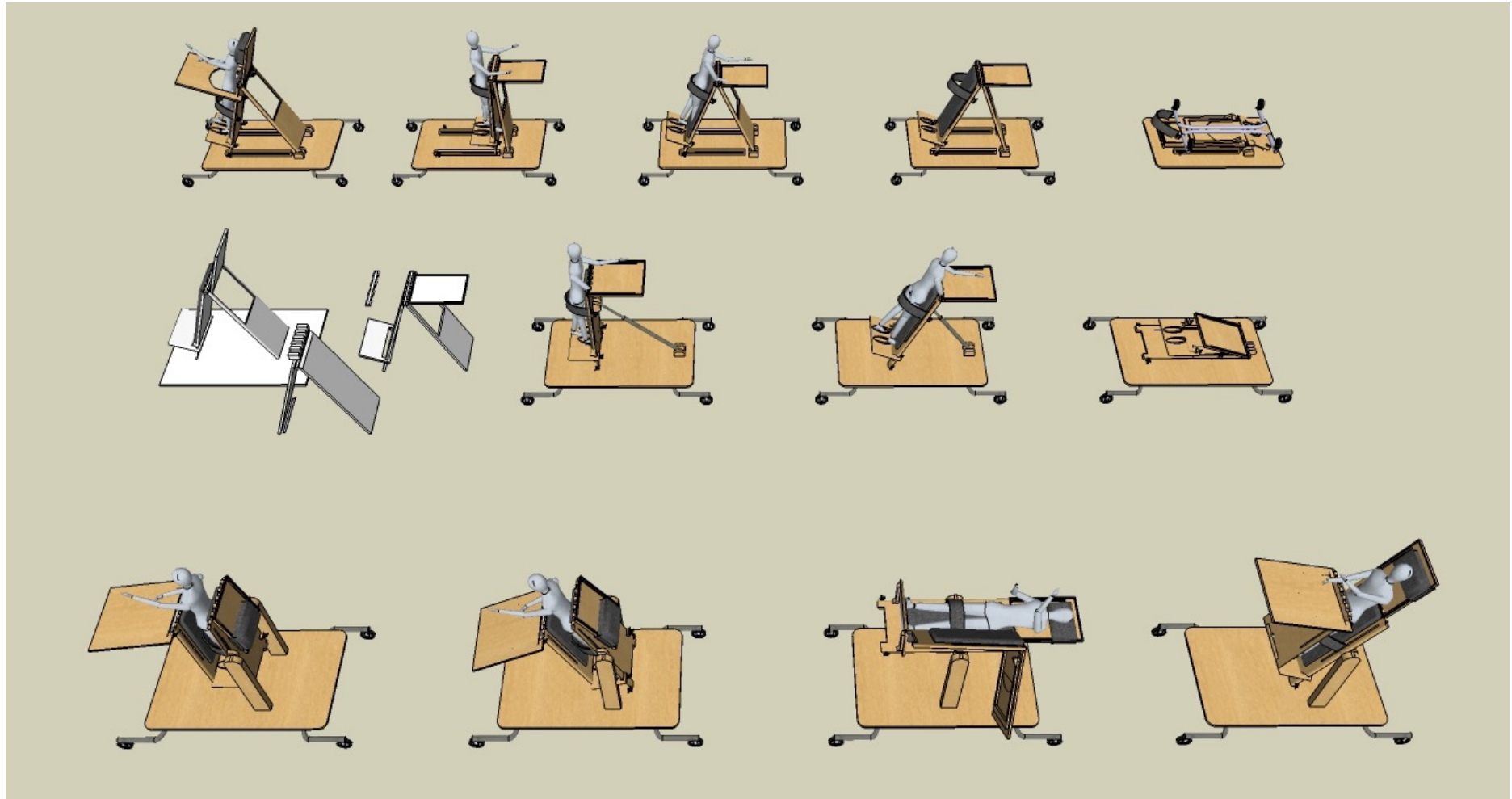


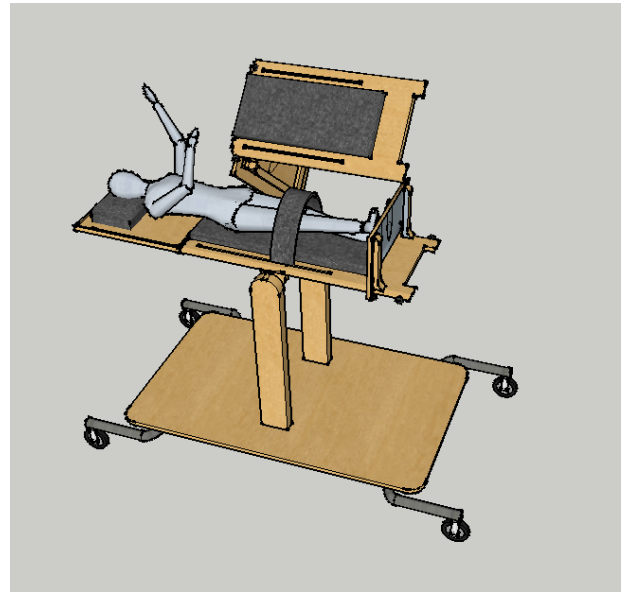
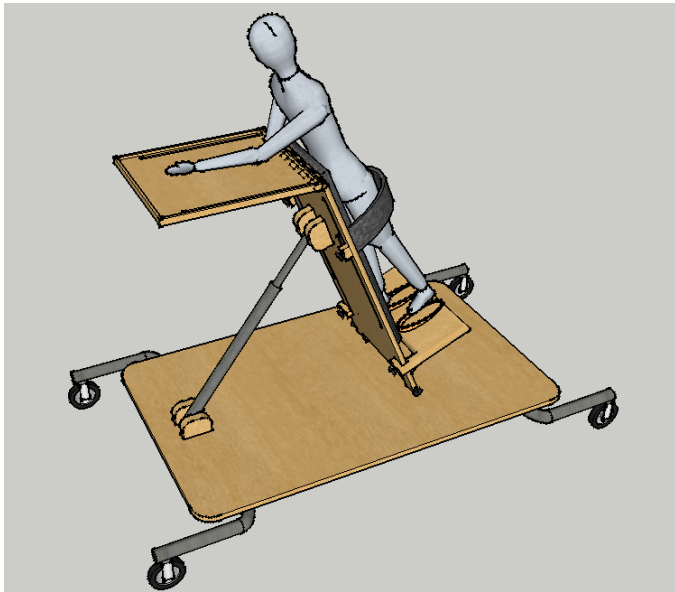


Above sketch was the final Ideation of the initial concept. Instead of two sides in the initial concept, Only one side can be used for both the supine as well and prone. The sides of the stander rests

on a platform with recesses where the ends of the stander can be placed so that it doesn't slide away from position to position. Cushion can be then stuck on to the front and headrest attached.

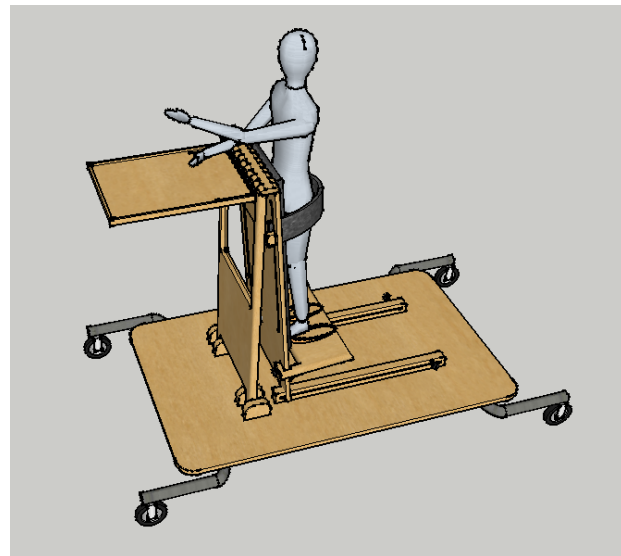
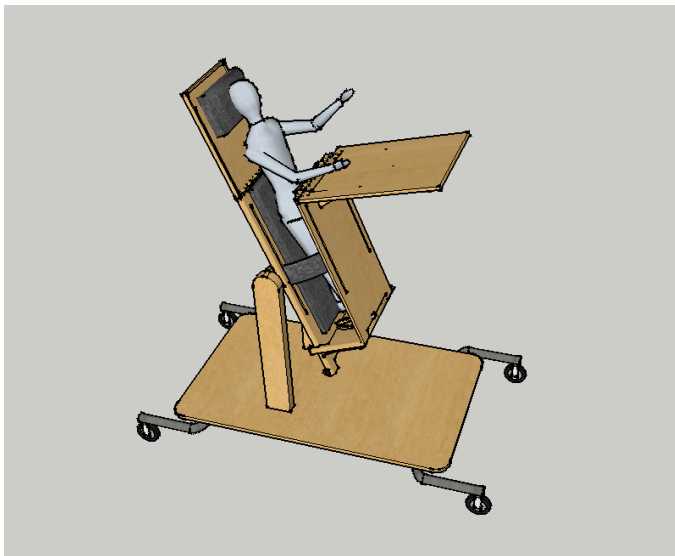




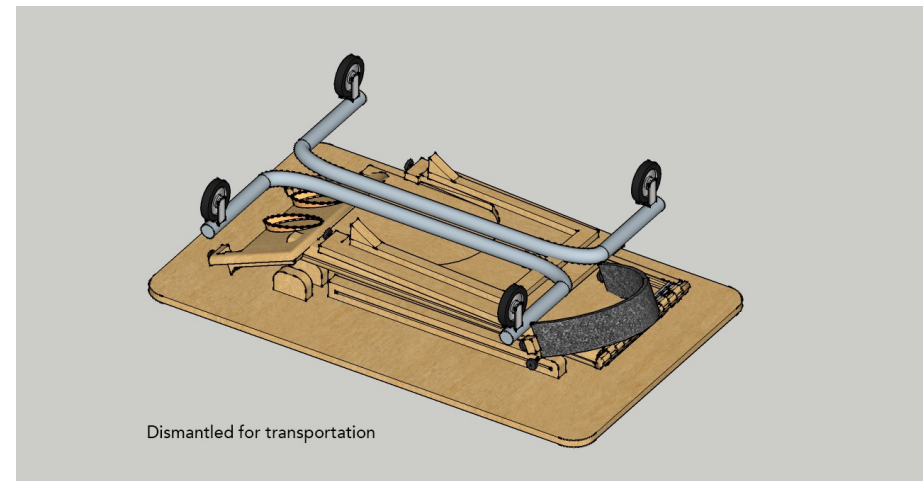
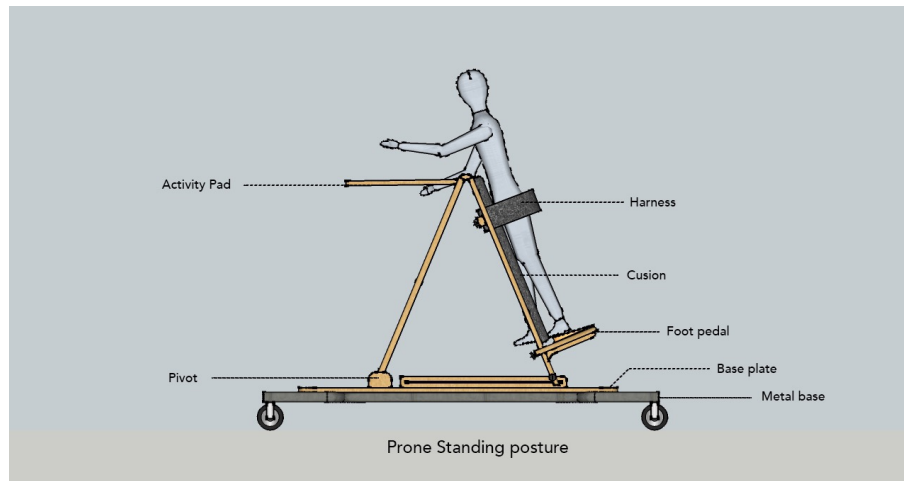
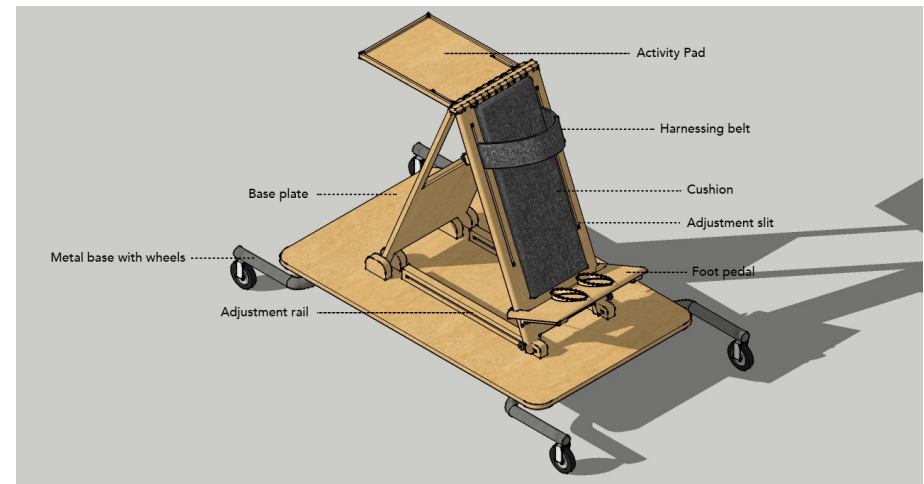
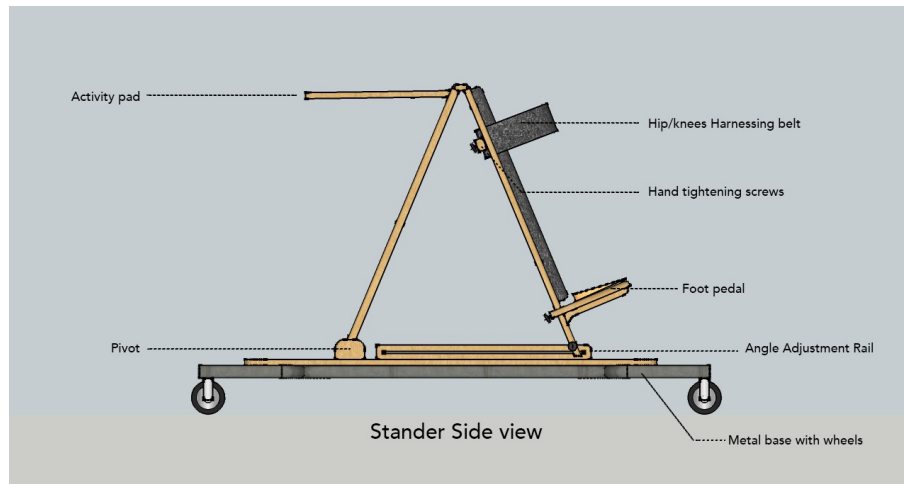


There were alternatives made to the initial concept to make it more practical to use in real life. More details were made to design for the transformation from one posture to another.

Three variations were made. One where all three postures can be made from one single change to the stander while the patient had to be removed from the stander and then placed in another way to make them stand in another position.



While the other supports just two postures and incorporates the use of piston on the other side of the stander to where the patient is standing. The one that had three postures was selected and further developed.







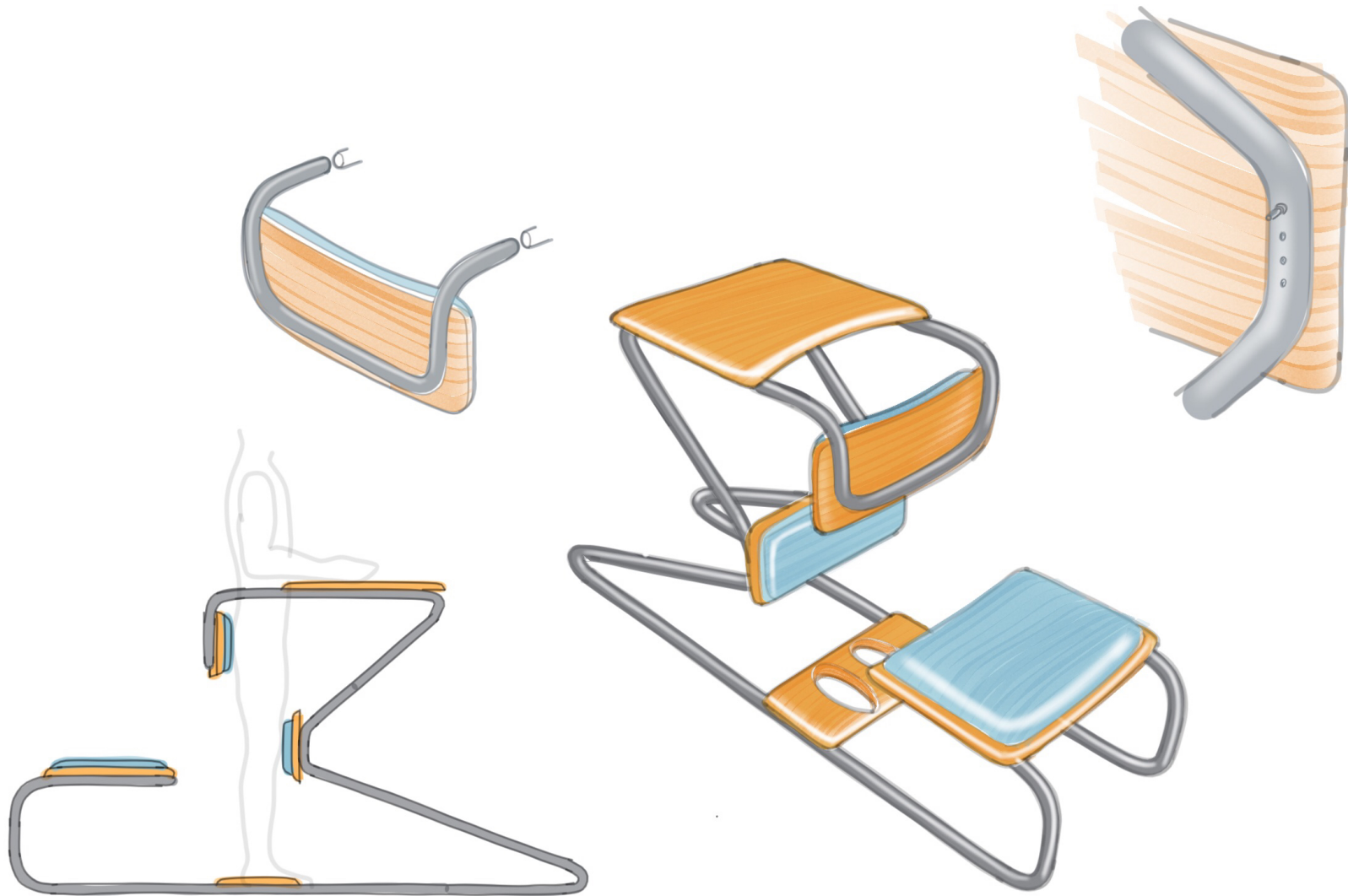
The Final working idea of the first initial concept looked like this. There was a pivot on the bottom of the back panel which stopped the back panel from sliding away from the base. And the front panel was made to stand on top of a railing which supported both the legs of the front panel. There was hand tightening screws which tightened the front panel from sliding away. And by tightening the front panel the the angle of the stander can be set.

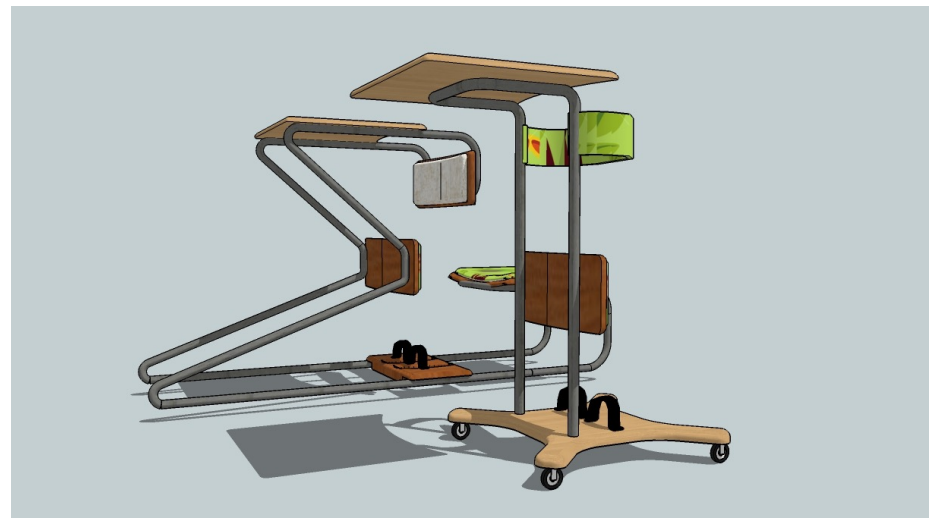
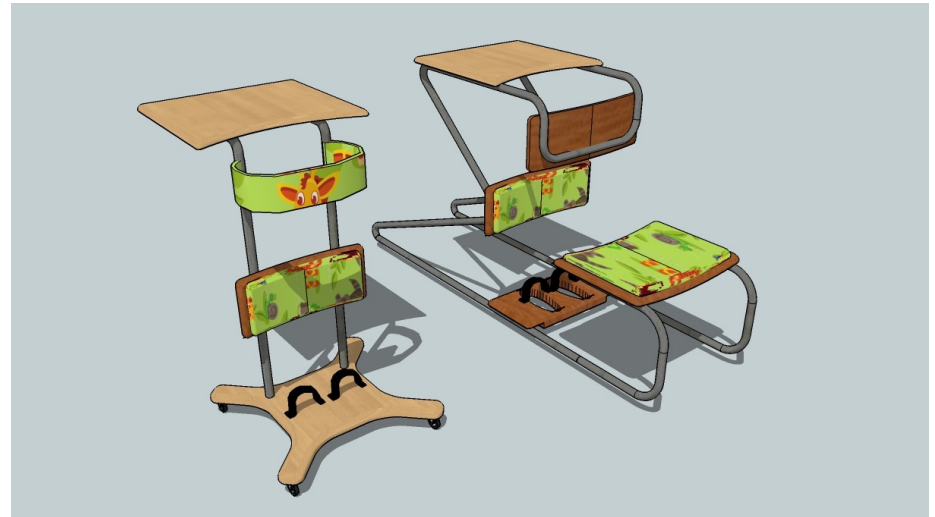
The activity tray can be opened out to the prone user on the front side who is facing towards the back side of the stander. The activity stander has a small stopper for stopping things to slip out of the tray. These two panels stand on top of the base which stands on top of the base frame. The base frame has wheels on four corners.

The front panel has a slot at the bottom from where the foot pedal can be inserted and adjusted to the wherever wanted. It has a small nook which sits on top of the front frame and holds the weight of the baby. The front panel also has velcro to which the cushions are stuck which can then be adjusted by replacing the location to wherever necessary. The location of the cushion and the foot pedal depends on the height of the baby. The baby can then be strapped using the elastic strap on the front side.

SWOT ANALYSIS	
STRENGTHS	WEAKNESSES
- Supports Multiple postures - Easy assembly/disassembly - Adjustable angles for different postures - Easy manufacturing - Locally available materials - Cheap materials and manufacturing - Easy modifications	- Not a children friendly design - Quite huge - High maintenance - Material wastage in unusuable parts - Easy usability is less possible - Adjustable Foot pedal - Sideways tilt - Push/pull handle bar - No modular parts
OPPORTUNITIES	THREATS
- More finishes to the final product - Look and feel of the product - Less wastage - One step foot pedal - Sideways balance - Children friendly design - Can be made small - Less material usage for less maintenance - Easy usability - Sideways Tilt	- Standers that look more like a toy - Even cheaper standers - Standers with Sideways tilt - Standers with automation - Products with sideways tilt

7.2 Concept 2







The second concept was a DIY concept where the materials needed to manufacture the product are available locally. And the manufacturing process doesn't need a professional. The blueprint could be available online or in the PMR centre which the patients can collect and make them themselves or can be made once given to the suitable fabricator. It doesn't take much time or money to these designs.

The designs however are as simple as it could be. It just has bent tubes and plywood panels for support. The first design in the picture is an upright stander where the patient can be made to stand on the foot pedal and their feet can be strapped with the base strap that is attached on top of the base. The base sits on top of four wheels. The base is designed in such way so that it doesn't topple when the patient is made to stand not top of it.

From the base there are two tubes that run along the front side of the stander and is bent at the top where the activity tray sits and its fixed with two hand tightening screws at the bottom of the tray. which can then be adjusted by replacing the screws at the desired position. The knee rest sits at the middle which also can be adjusted similar to the activity tray on the top. The buttock strap is attached just below the activity tray which has a loop and velcro tightening mechanism.

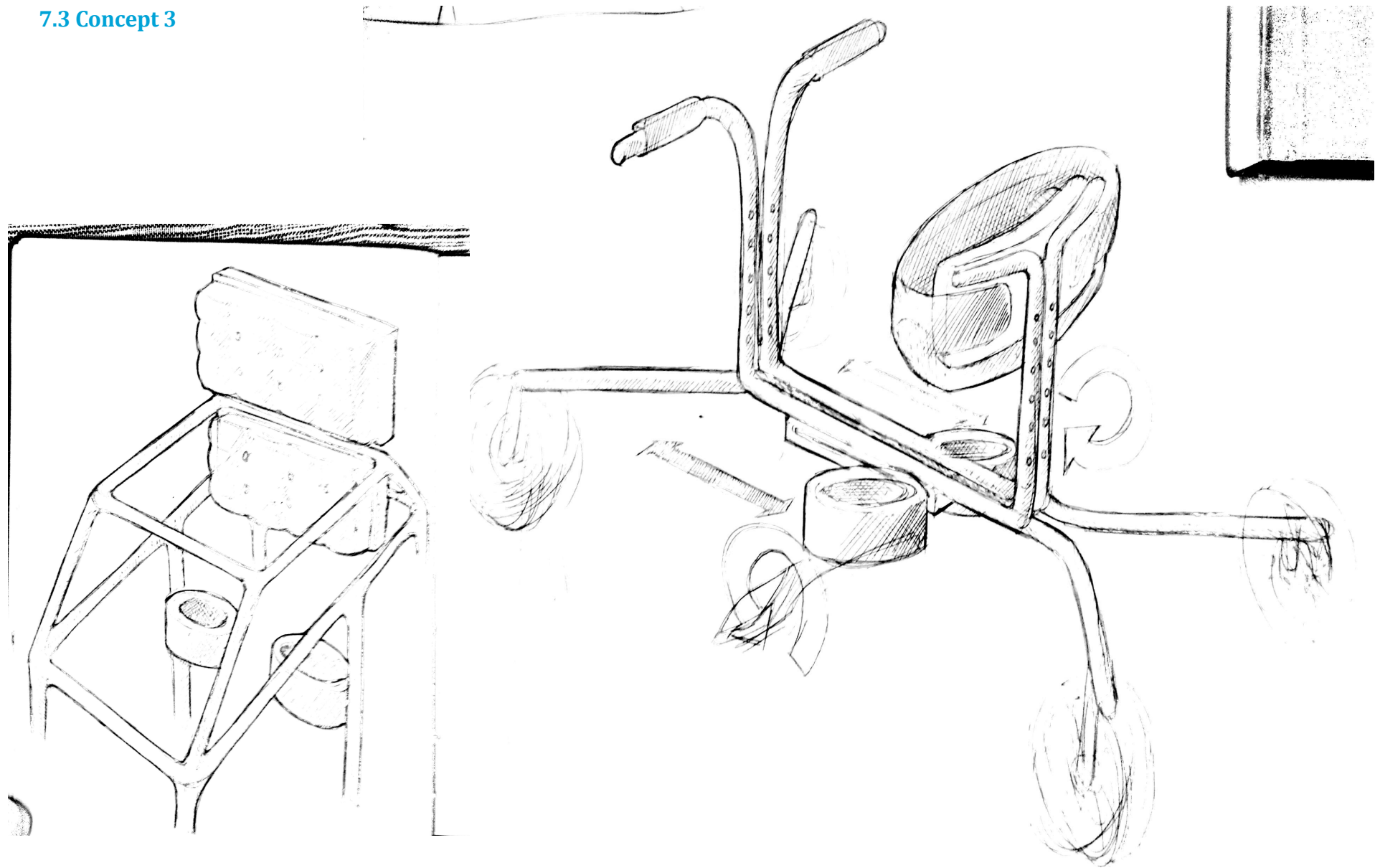
The second design on the picture above is a similar concept. But since the concept has only the upright position, it has a seating feature from the standing position where the patient can sit during the internals of the therapy sessions right from the standing position. Unlike the first design this one has tubes bent in different angles for more balance while standing.

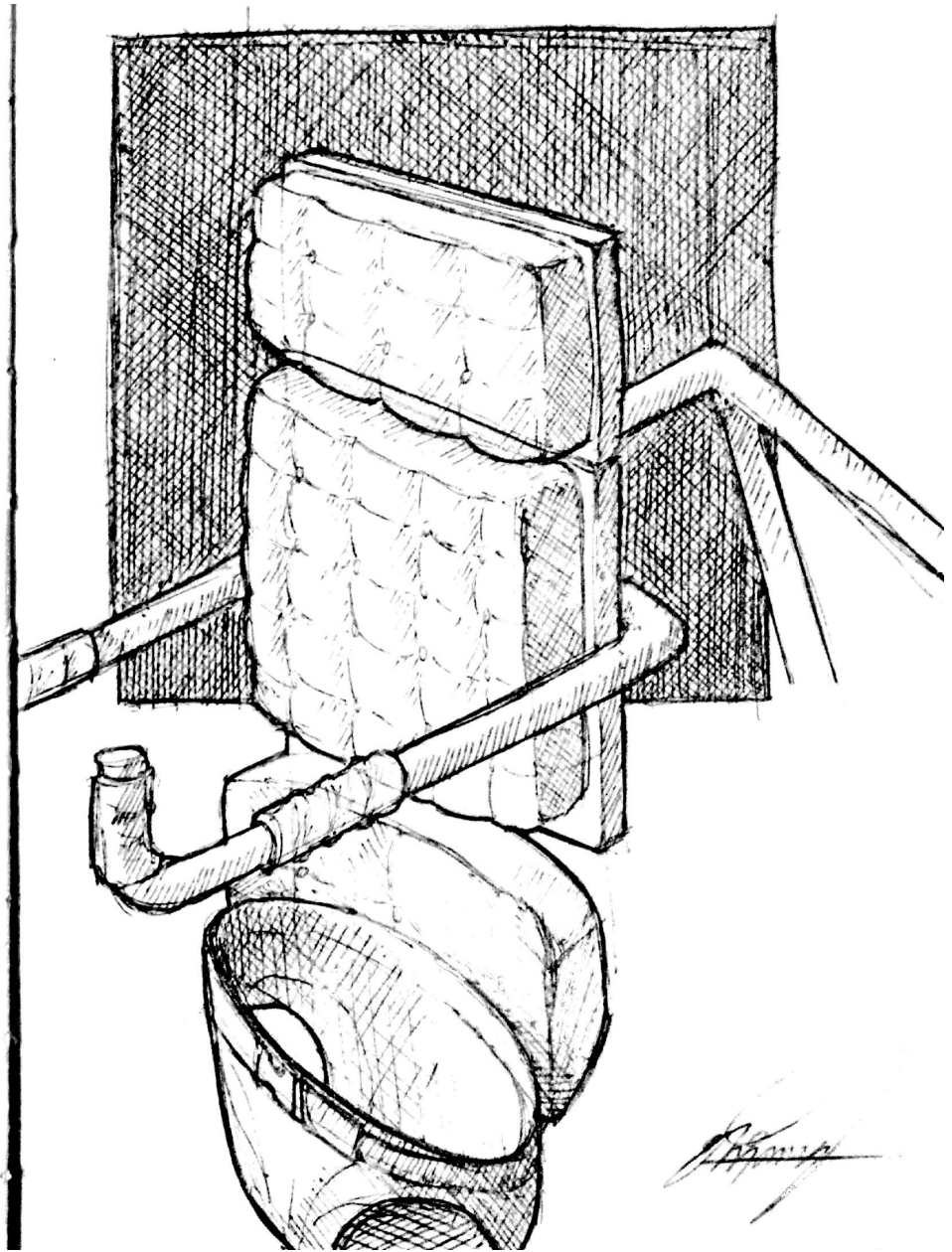
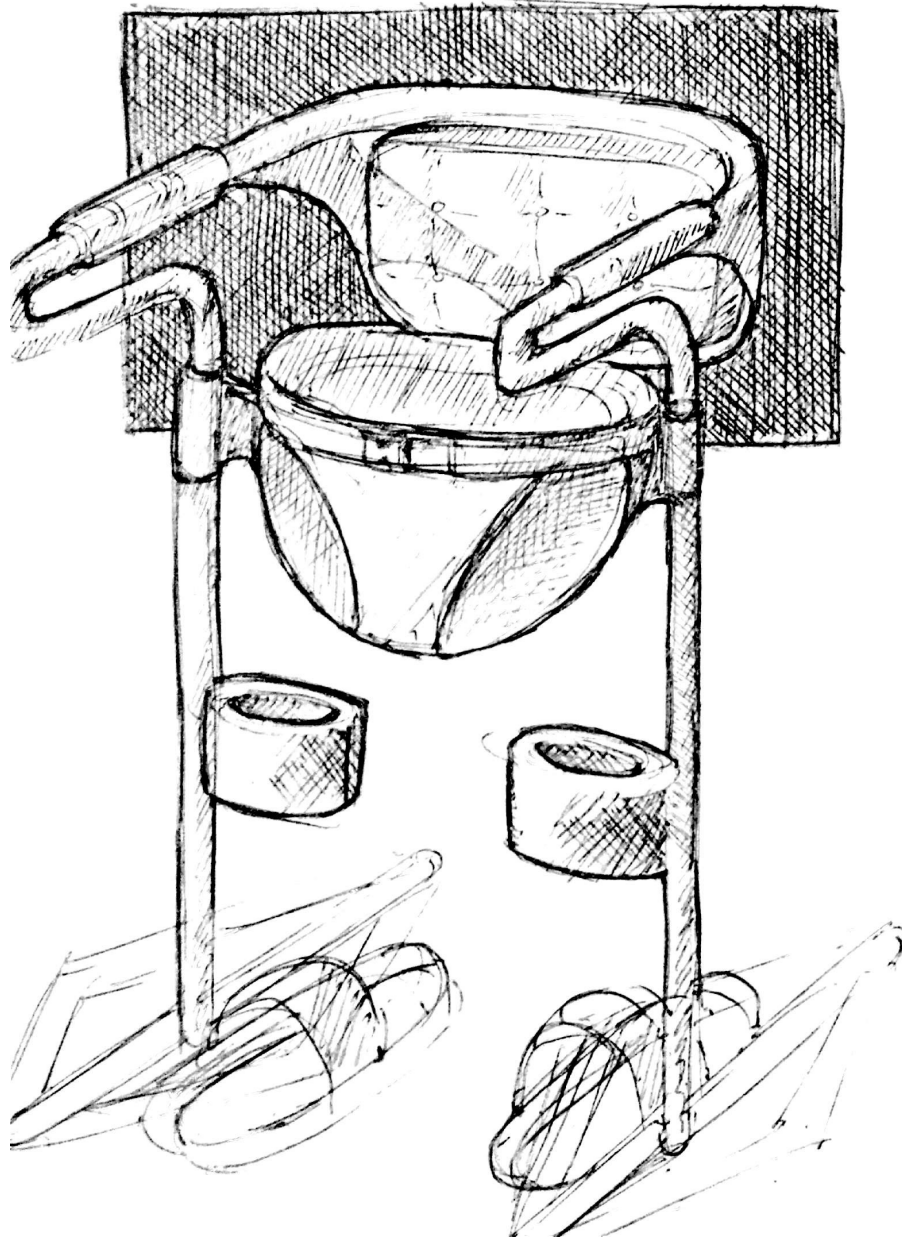
And unlike the first design the second one doesn't have strapping system but the tube is bent in such a way that it makes a door like curve at the back of the top side. It operates like a small bar door which is opened and the patient can then be made to stand and the door back support can be closed so the hip would not buckle. The knee is made to rest on the middle bend which can be adjusted to the patients size.

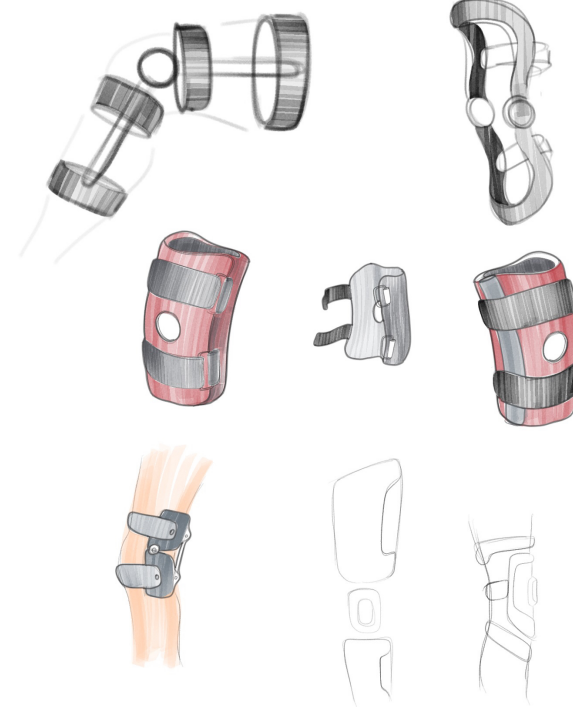
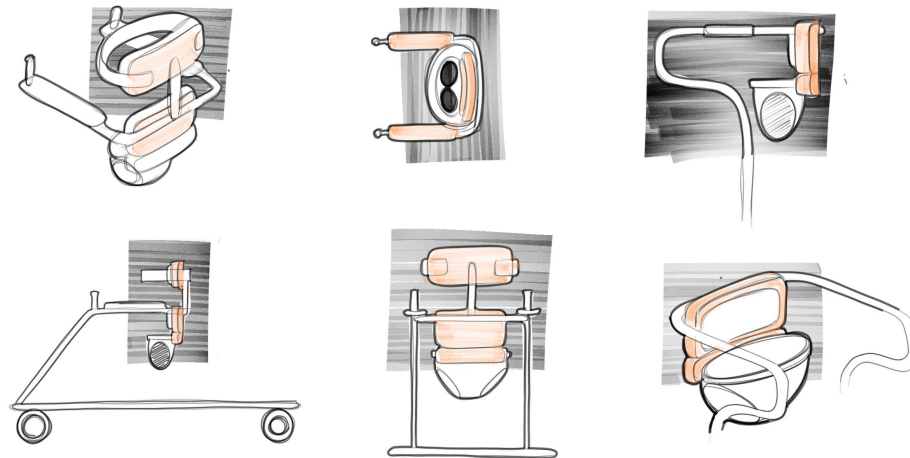
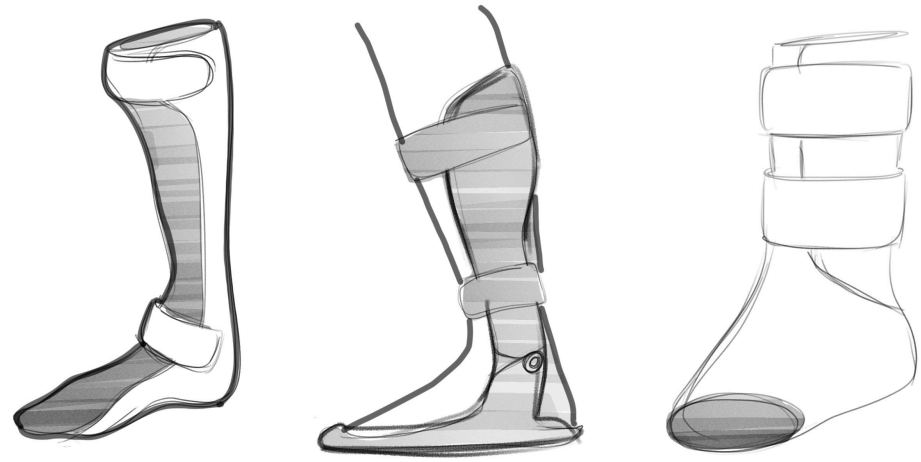
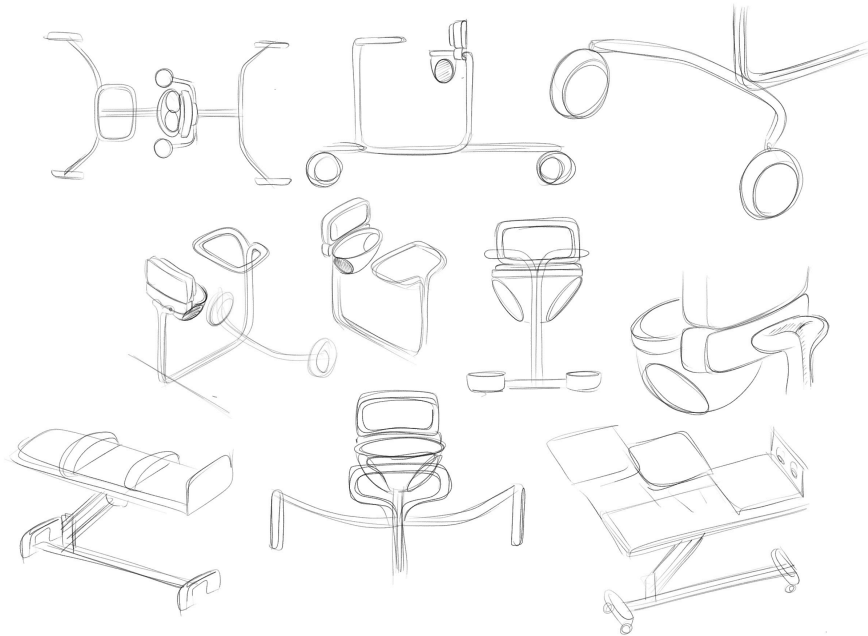
The problem with these concepts is that they does not bring anything new to the table. There are already existing upright standers that function better and can be transformed into some other position. While this stander supports only one single position, the doctors feel that the stander does not promote the patient to move around. In fact there is no room to move around in a stander like this since it only supports the patient to stand in one single position as they are strapped into position rather than made to stand in a position.

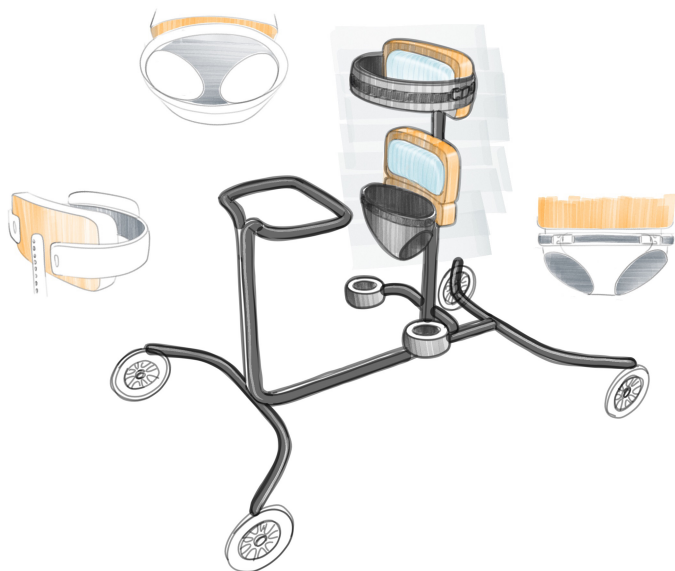
SWOT ANALYSIS	
STRENGTHS	WEAKNESSES
Easy assembly/disassembly Easy manufacturing Locally available materials Cheap materials and manufacturing Sitting to Stand posture Anyone can assemble DIY	Not a children friendly design Quite huge Requires large space Ease of use No Adjustable Foot pedal No Sideways tilt No Push/pull handle bar No modular parts Single posture No Modifications
OPPORTUNITIES	THREATS
Adjustable foot pedals Adjustable knee pad and activity tray Sideways balance Adjustable parts can be made Children friendly design Can be made small Less material usage for less maintenance Easy usability Sideways Tilt	Standers that look more like a toy Even cheaper standers Standers with Sideways tilt Standers with automation Products with sideways tilt

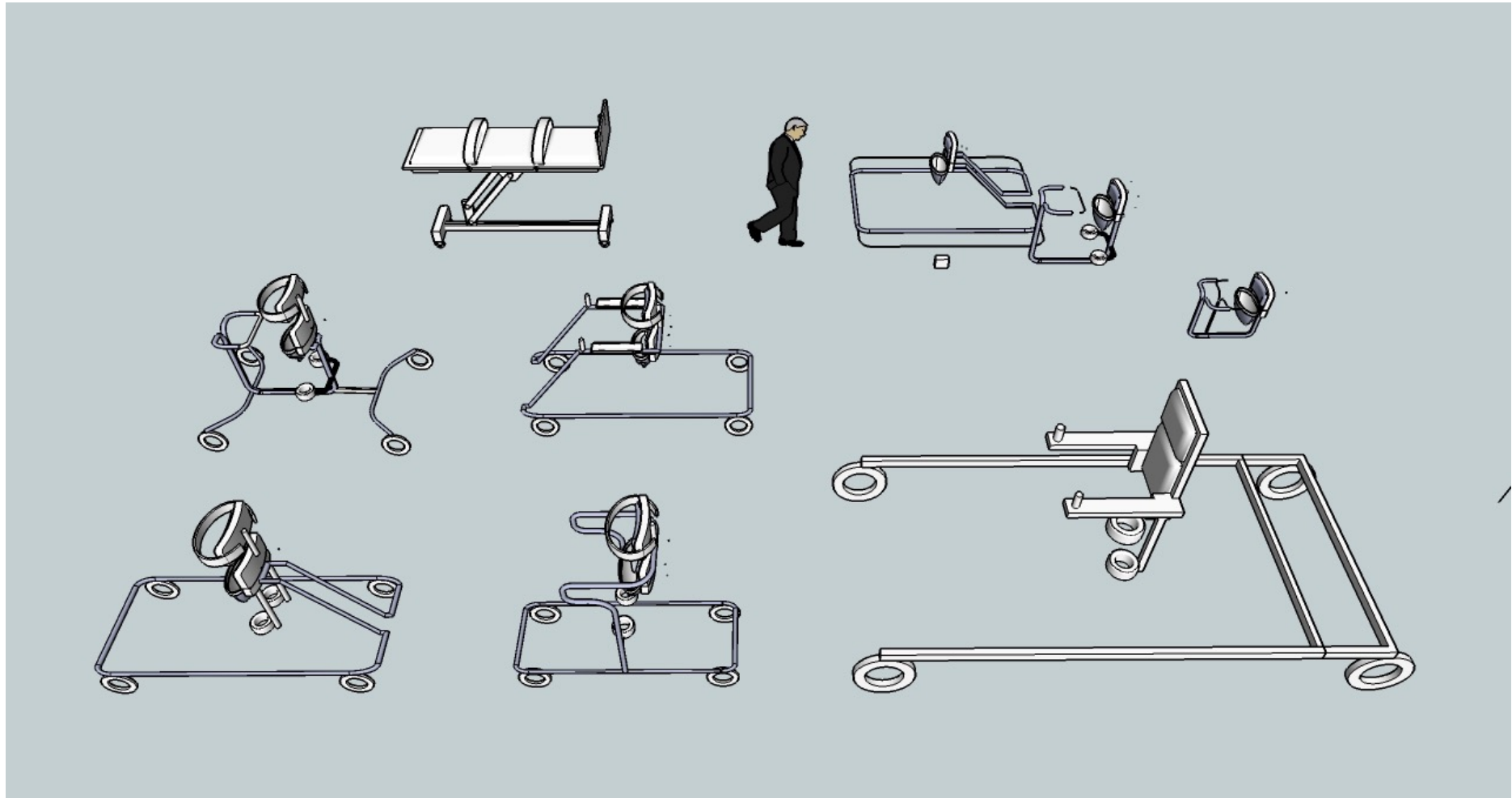
7.3 Concept 3

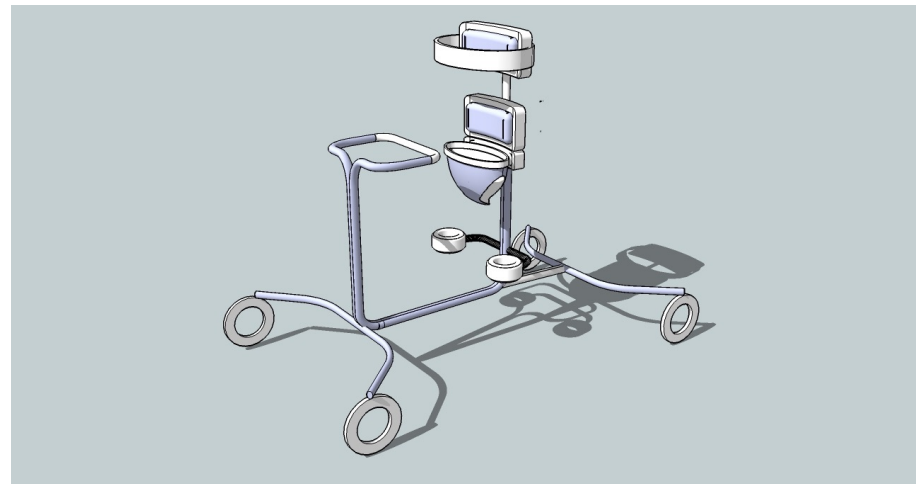
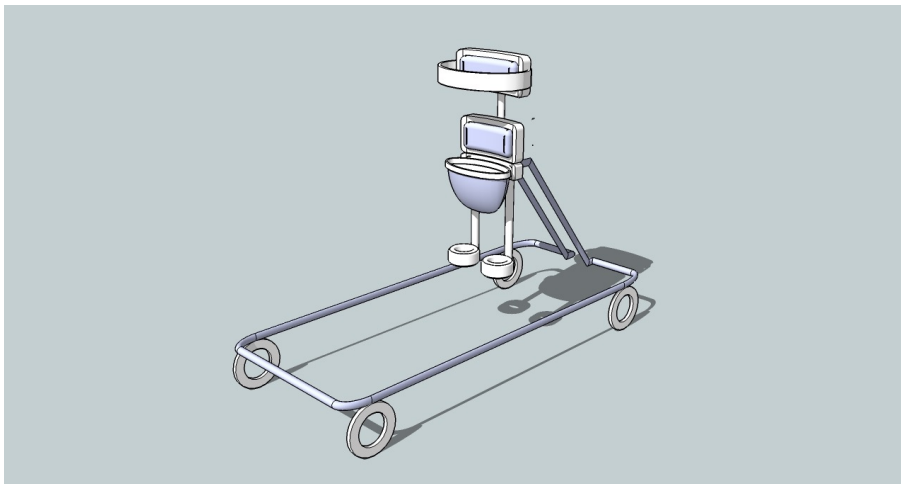
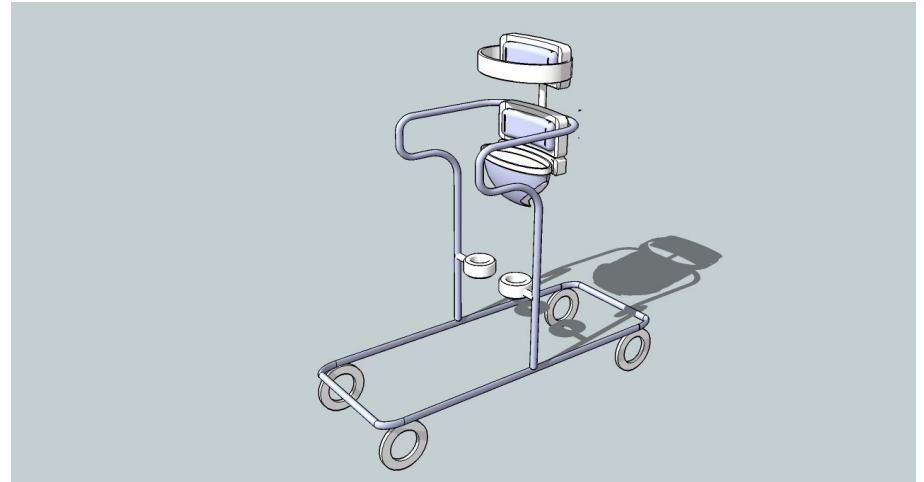
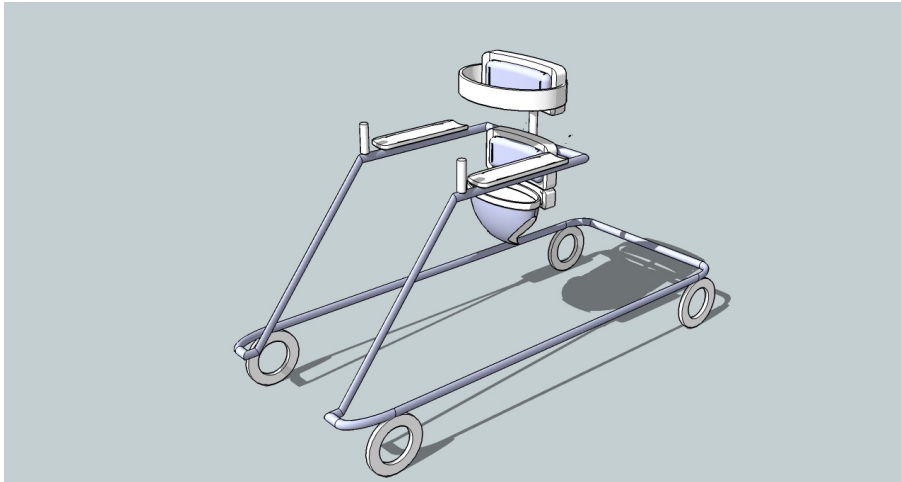


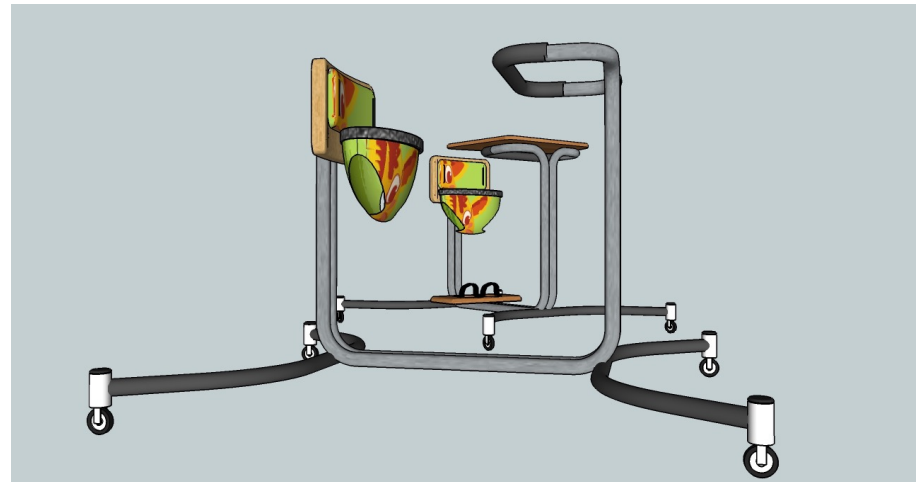














The third concept was an idea to combine standing and walking. Once the child has got some strength and stability in their lower limbs, the child can use the same device to learn walking. This won't be your regular walker with only hand support. The child would be made to stand on the foot pedal and their feet strapped and their knees are free in this case unlike the earlier concepts since they can sit on the seat if their legs cannot take their weight.

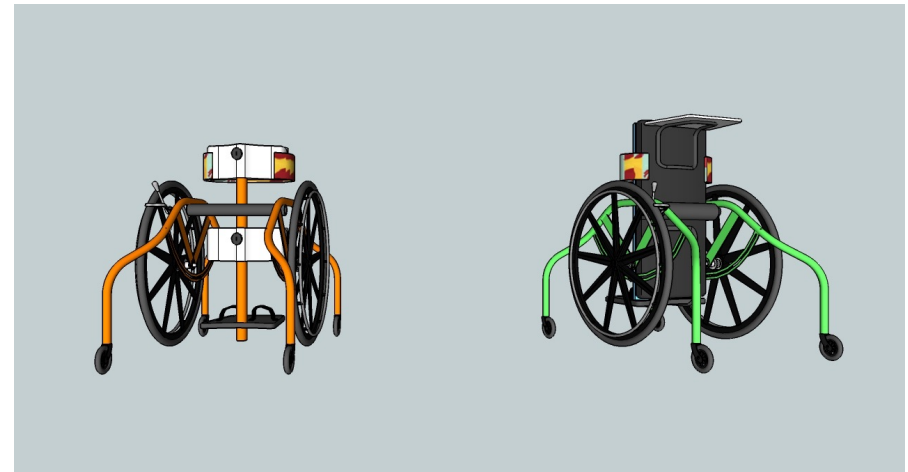
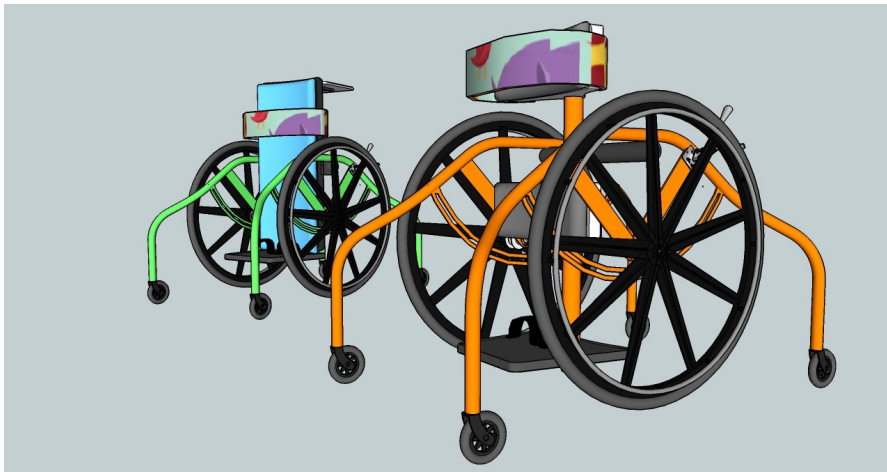
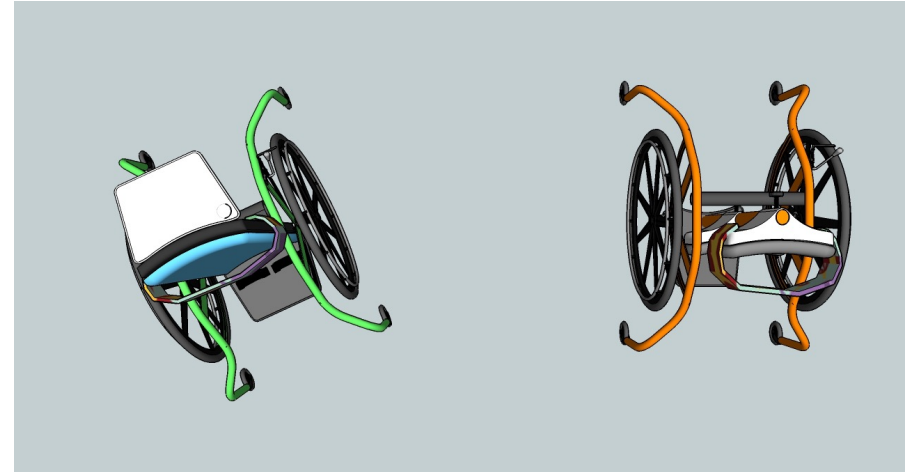
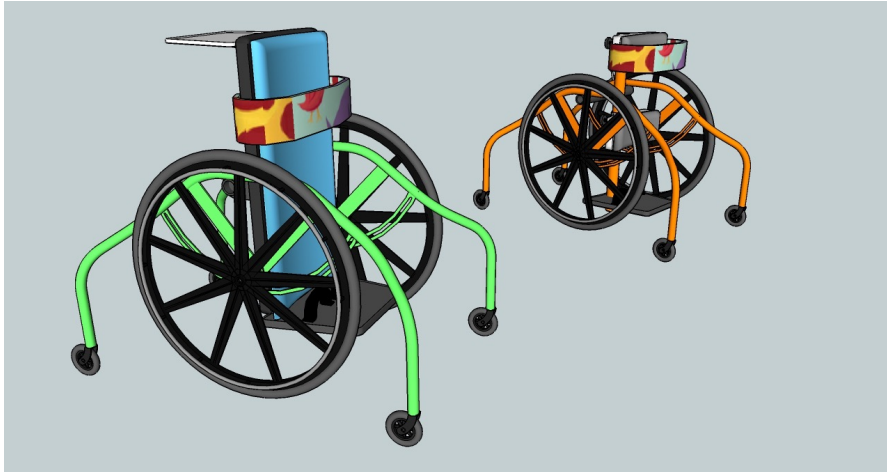
The final ideation looks kinda like a scooter where the patient can sit on the hip strap and hold the handle bar while they may or may not hold their weight with their legs. The activity tray can be placed on top of the bent tube and can be then adjusted to desired location. The back rest is attached to the bent tube that rises from the back side to the top. The back rest is made of wood and cushion is attached to the wood. The seat is attached to the same wood that the cushion is attached.

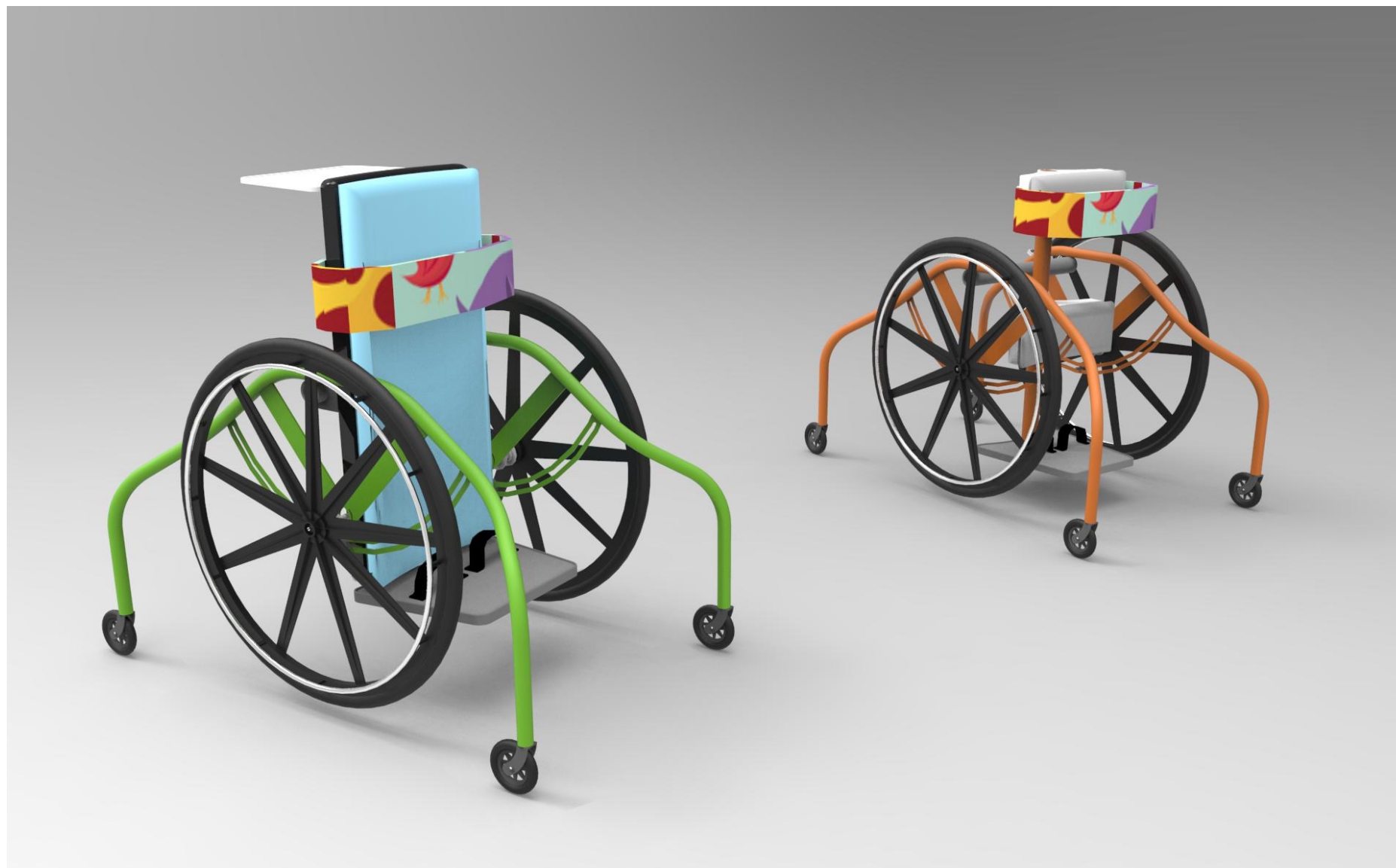
The bent tube themselves are cut at three positions and push button extension mechanism is slid in. The base tube is bent in shape of an X to make it more stable and four wheels are attached to each end of the X. The problem with this concept is that there are walkers that are available that do the perfect job in making the child just walk or stand. And that there was a reason that two different devices were kept separate.



SWOT ANALYSIS	
STRENGTHS	WEAKNESSES
- Combination of stander and walker - Modular parts - Detachable parts - Adjustable sizes for different sized children - Children friendly design - Unique design concept - Adjustable parts - Mobile - Multipurpose back rest	- Supports only one posture - No Adjustable Foot pedal - No Sideways tilt - No modular parts - Single posture - No Modifications - No adjustable posture angles
OPPORTUNITIES	THREATS
- Option for second posture - Adjustable foot pedals - Sideways tilt - Adjustable parts can be designed - Modifiable parts - Adjustable posture angles - Easy usability	- Standers that look more like a toy - Even cheaper standers - Standers with Sideways tilt - Standers with automation - Products with sideways tilt

7.4 Concept 4





The third concept is more like a take on an existing models. Its called a mobile stander. It's like a wheelchair but the patient is made to stand on it instead of sitting. If the patient has an upper body control and strength, they can use the wheels on the side to move around just like how they would on a typical wheelchair.

Similar to the earlier concepts there are bent tubes on the sides. It is bent in such way that it could accommodate an entire wheel which is projected a bit above the tube so that its accessible to the patient. The bent tube also has an arch starting from one side to another which is welded to the bent tube for angular changes. The Bent tubes are connected at the middle by welding. The welded tube in the middle is used as an pivot where the leaning pad is attached.

The angular arch is connected to the central leaning pad by hand tightening screws. The hand tightening screws are used to tighten the leaning pad to whichever angle desired. At the bottom end of the leaning pad is the foot pedal which sits on top of the bent oval tubes which has two push button extension mechanism to hold the weight of the baby. And on top of the leaning pad is the activity tray which had a similar detail to the one that is on the bottom. The Tray sits on top of two oval tubes with push button extension mechanism.



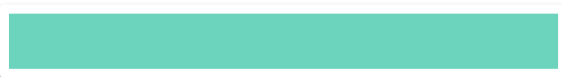
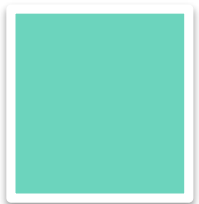
SWOT ANALYSIS	
STRENGTHS	WEAKNESSES
- Combination of wheelchair and stander - Wheels for mobility - Adjustable sizes for different sized children - Unique design concept - Adjustable parts - Mobile - Multiple postures - Adjustable angles	- Expensive - Less practical - Supports only one posture - No Sideways tilt - No modular parts - Single posture - No Modifications - No adjustable posture angles
OPPORTUNITIES	THREATS
- Option for second posture - Adjustable foot pedals - Cheaper version - Sideways tilt - Adjustable parts can be designed - Modifiable parts - Adjustable posture angles - Easy usability	- Standers that look more like a toy - Even cheaper standers - Standers with Sideways tilt - Standers with automation - Products with sideways tilt

7.5 Concepts Validation

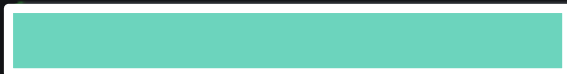
The four Initial concepts were validated with the help of three physiotherapists and a professor. These were the criteria that all the concepts had to comply with. The first concept was initially

approved by the physiotherapists. But aesthetically it looked more like a clinical device than a product for a baby. So Another ideation had to be worked on and to make it look more like a toy.

Concept	Easy Storage	Easy Assembly	Multiple Postures	Adjustable for different kids	Adjustable Angles	Modular	Children friendly	Manufacturing Processes involved	Manufacturing cost estimation	Materials
Concept 1	Yes, Can be folded and easily stored	Yes	Yes	Yes	Yes	Yes	No	1 - Wood Working	10,000 - 12,000 INR	Mostly Wood
Concept 2	No, Cannot be modified once manufactured	Yes	No	No	No	No	No	2 - Wood Working and Tube bending	3000 - 4000 INR	Wood and Steel
Concept 3	No, Has to be Dismantled before stored	Yes	No	Yes	No	No	Yes	2 - Wood Working and Tube bending	8000 - 10,000 INR	Wood and Steel
Concept 4	No, Cannot be stored unless dismantled	No	Yes	Yes	Yes	No	No	More than 3 - Tube bending, Injection moulding, Leather and Metal work	More than 25,000 INR	Wood, Leather, Plastic and Steel



what is the purpose of this stander? Despite of being a torture machine for naughty children?

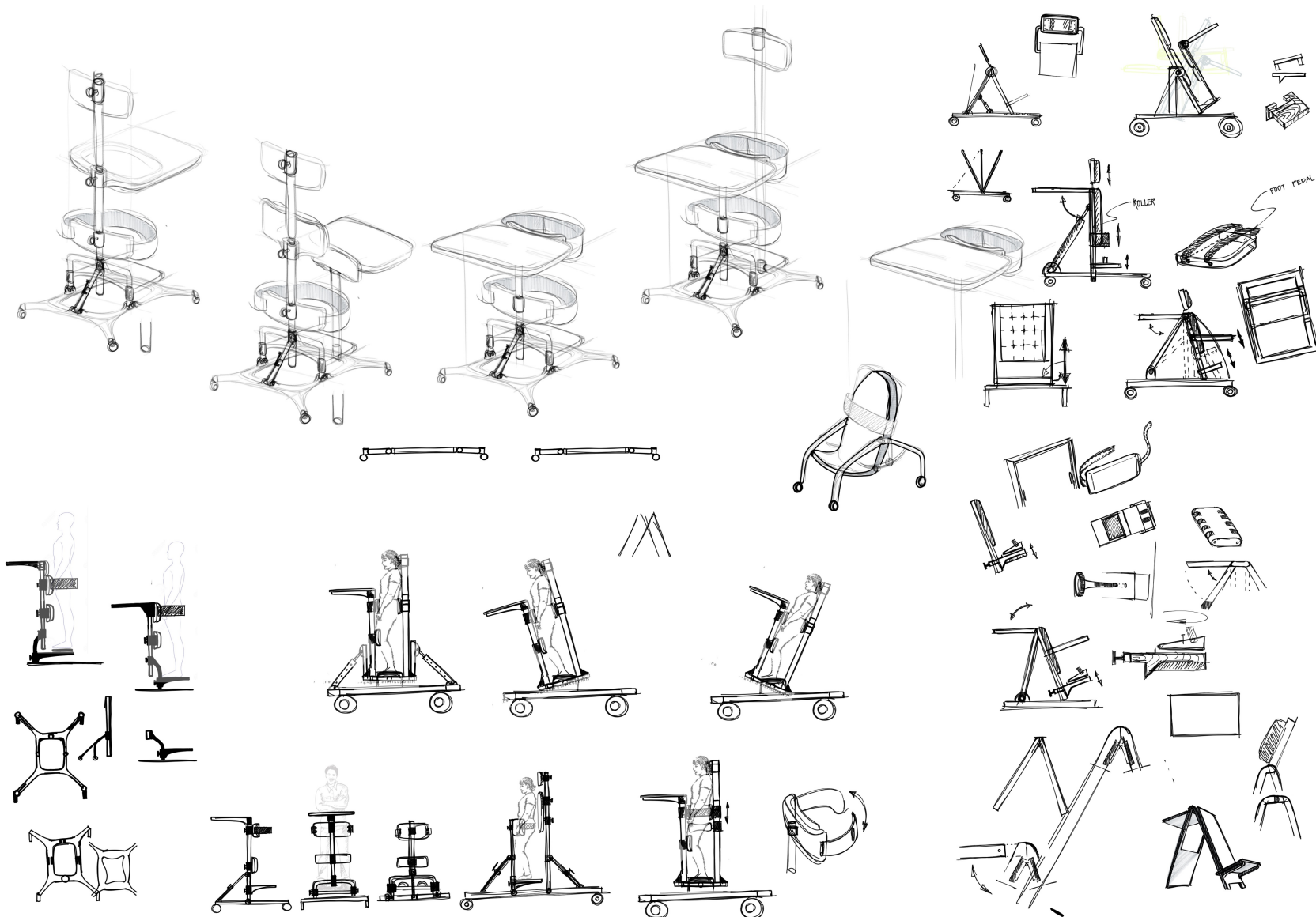


Is that a torture device ? XD



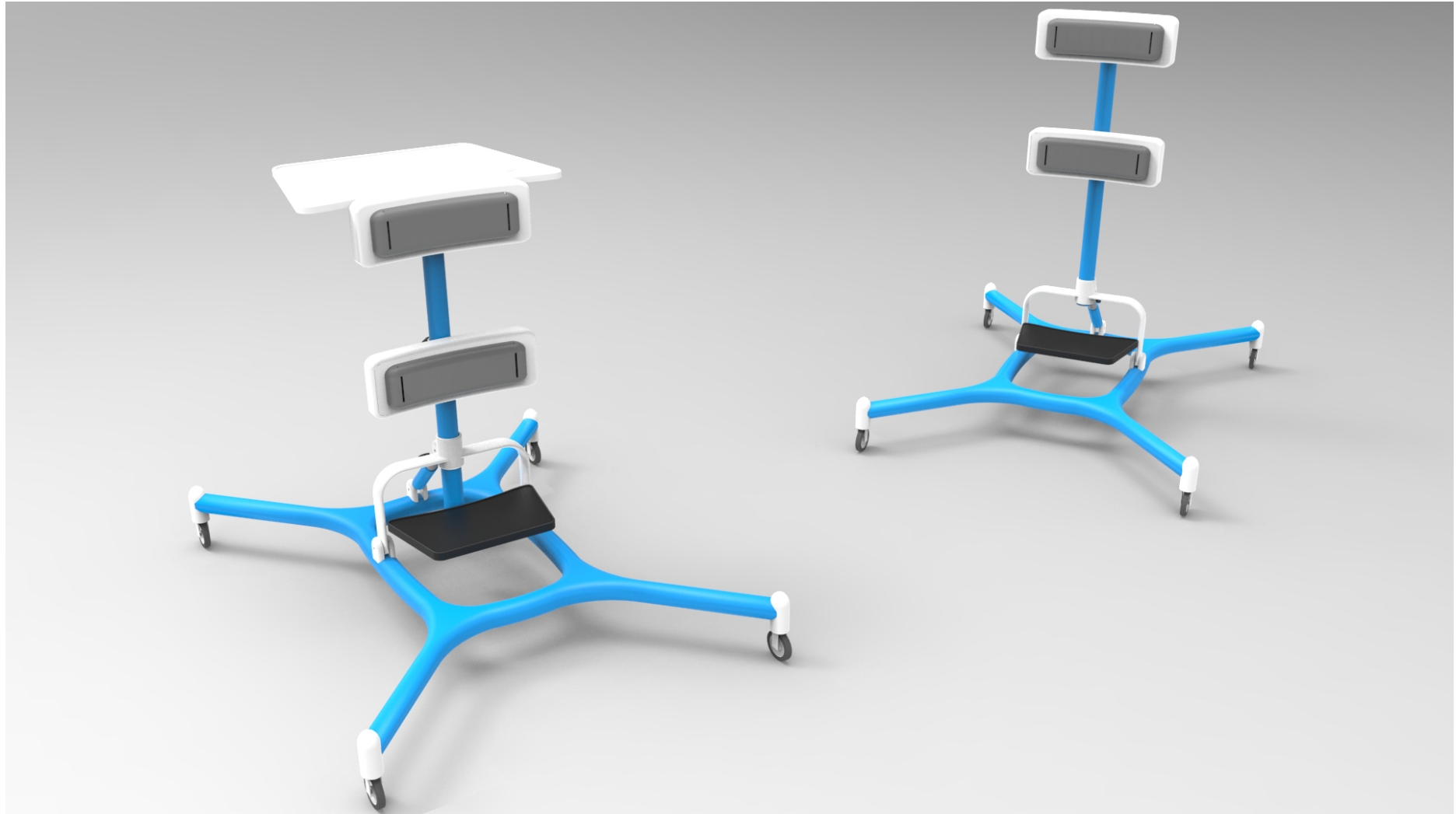
The images finalised initial concept 2 was shown to the classmates, professors and research was made on same subject on similar stander online. The one thing that everyone had to agree on was that like said earlier it looked more like a torture machine or a clinical device if you must rather than a product for a child. The products that children uses mostly are toys. So studies were done to identify forms and design patterns of toys and existing walkers and standers. They usually had rounded edges and corners with vibrant colours and had circular forms.

7.6 Concept 5



This was the final concept which was designed from all the earlier studies and inferences. This concept got finalised and

working details were made and materials finalised.



There were still details that were not practical enough to be fabricated so the details such as the base frame and junction

between the base frame and the core tube had to be changed. Instead of injection moulded base, metal tubes were used.





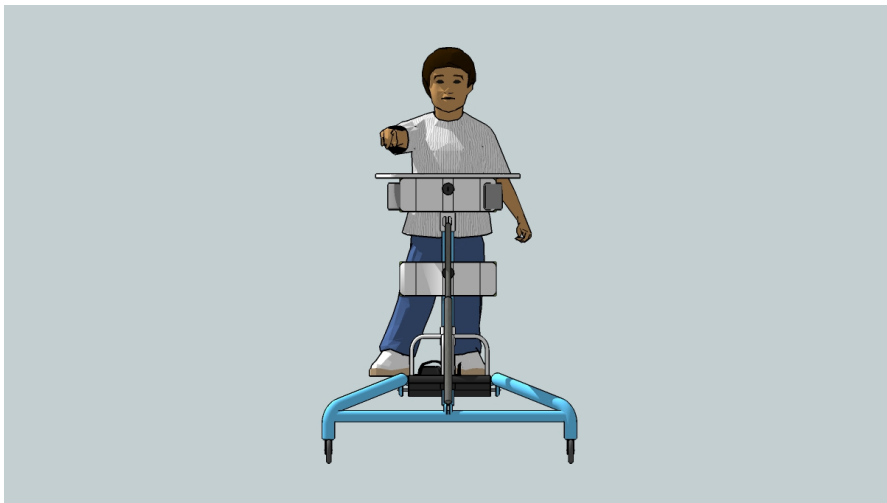
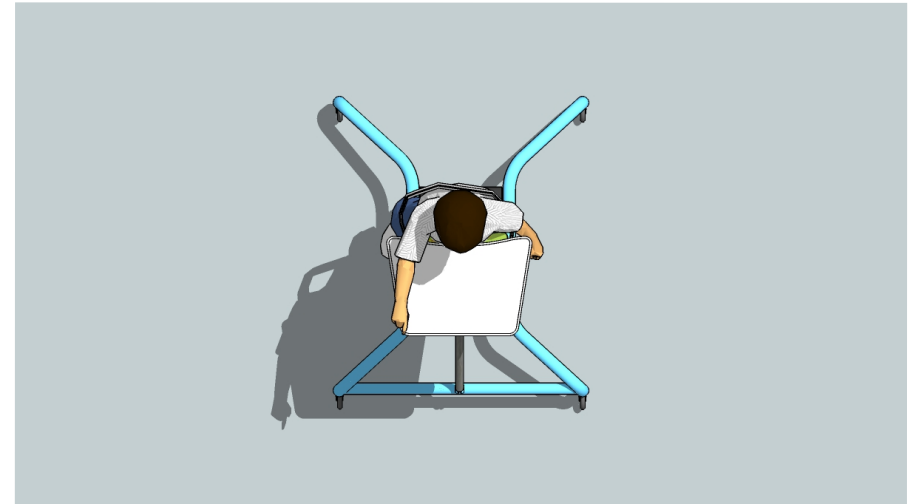




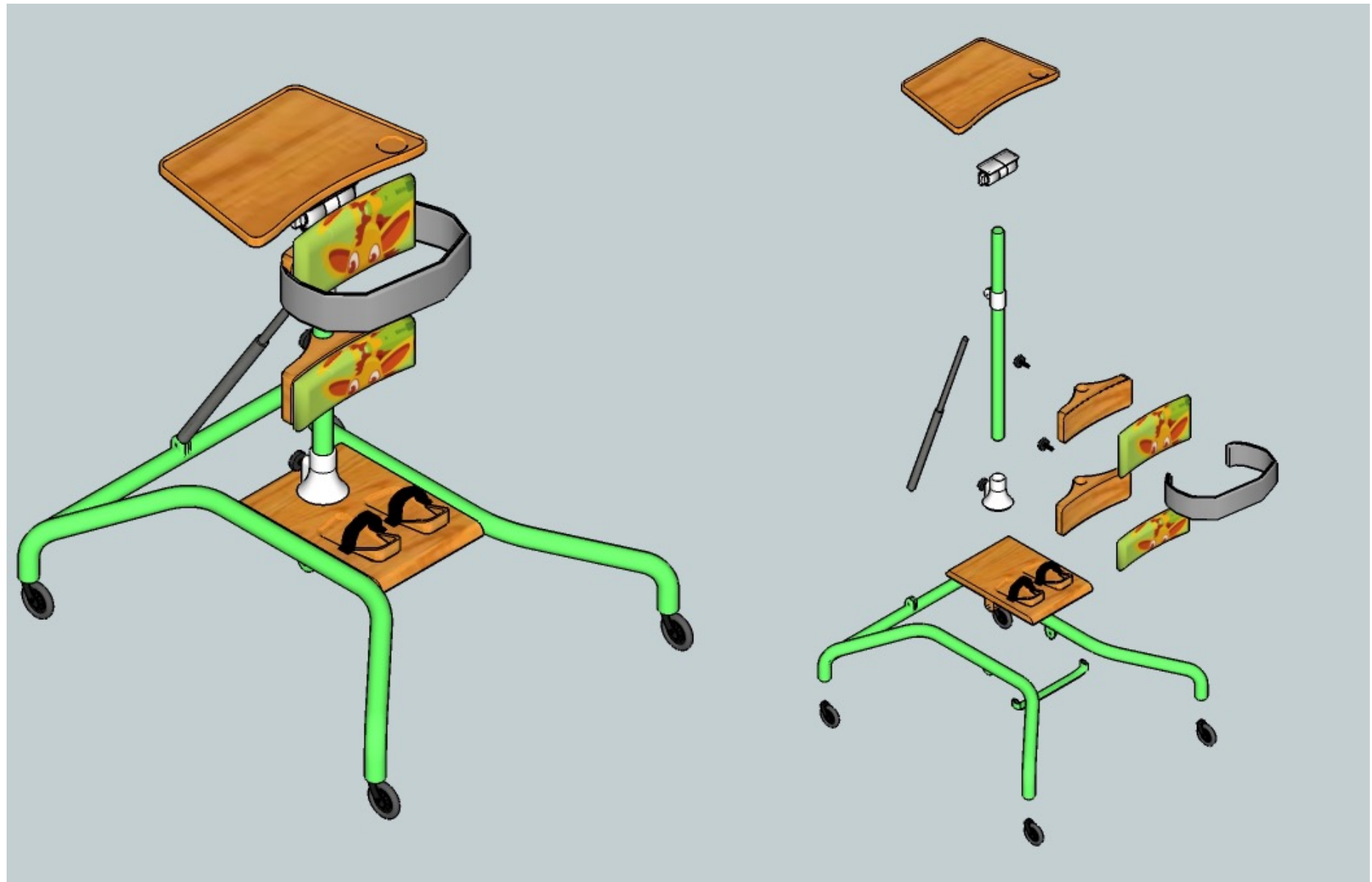


Concept	Easy Storage	Easy Assembly	Multiple Postures	Adjustable for different kids	Adjustable Angles	Modular	Children friendly	Manufacturing Processes involved	Manufacturing cost estimation	Materials
Concept 1	Yes, Can be folded and easily stored	Yes	Yes	Yes	Yes	Yes	No	1 - Wood Working	10,000 - 12,000 INR	Mostly Wood
Concept 2	No, Cannot be modified once manufactured	Yes	No	No	No	No	No	2 - Wood Working and Tube bending	3000 - 4000 INR	Wood and Steel
Concept 3	No, Has to be Dismantled before stored	Yes	No	Yes	No	No	Yes	2 - Wood Working and Tube bending	8000 - 10,000 INR	Wood and Steel
Concept 4	No, Cannot be stored unless dismantled	No	Yes	Yes	Yes	No	No	More than 3 - Tube bending, Injection moulding, Leather and Metal work	More than 25,000 INR	Wood, Leather, Plastic and Steel
Concept 5	Yes, Can be easily dismantled and stored	Yes	Yes	Yes	Yes	Yes	Yes	2 - Wood and Metal working	10,000 - 12,000 INR	Mostly Wood and Steel

Anthropometry					
Part	Age	Unit	Mean	Minimum	Maximum
Weight	18 months	kg	11.2	8.3	13.6
	24 months	kg	12.3	7.4	16.1
Height	18 months	cm	81.2	70.8	88.6
	24 months	cm	76.3	76.2	94.2
Shoulder - Elbow	18 months	cm	16	13.7	18.2
	24 months	cm	17.2	13.9	21
Elbow - hand	18 months	cm	21.3	18.5	24.6
	24 months	cm	22.8	19.3	26.1
Sole - Crotch	18 months	cm	0	0	0
	24 months	cm	34	29.2	37
Knee - Sole	18 months	cm	22.3	18.7	25.1
	24 months	cm	24.3	20.5	28.1

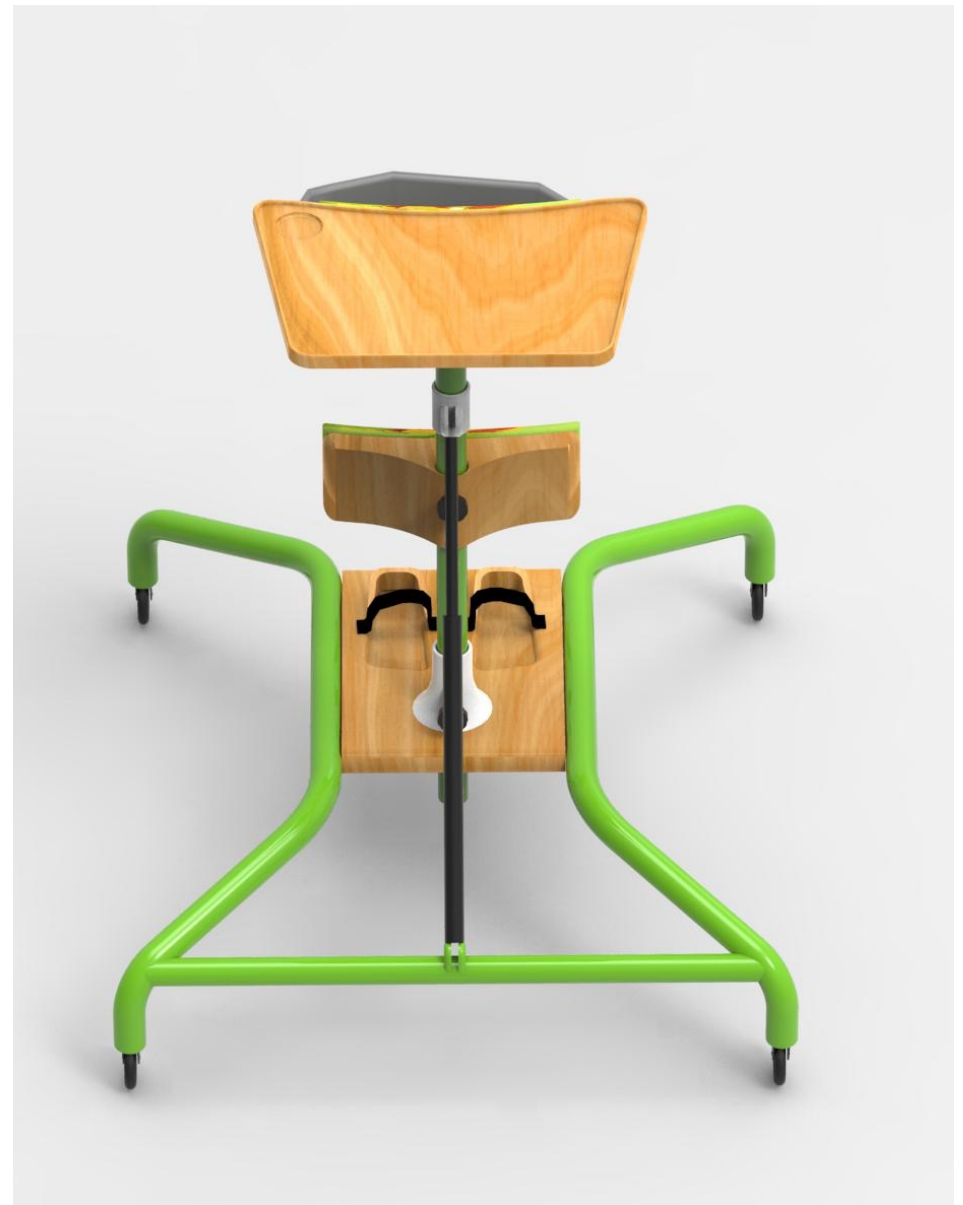


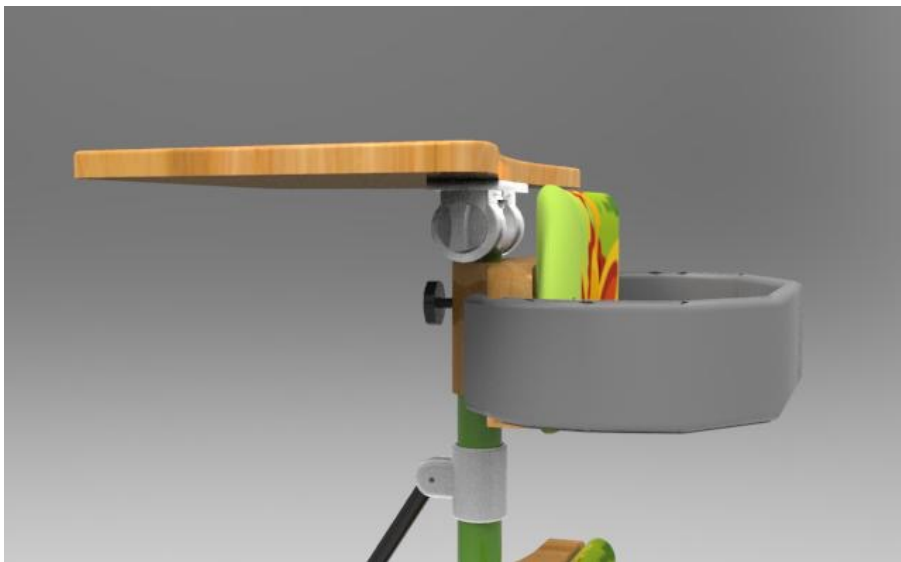
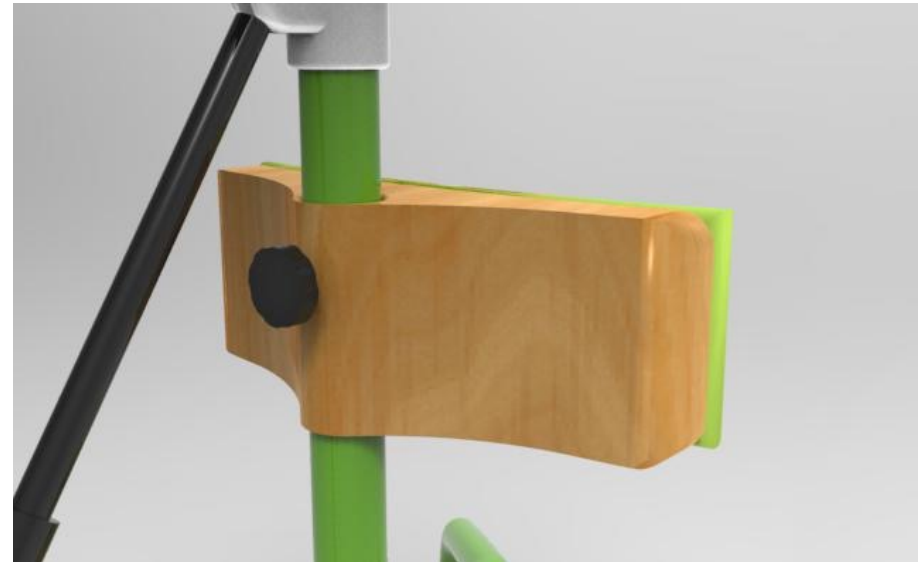
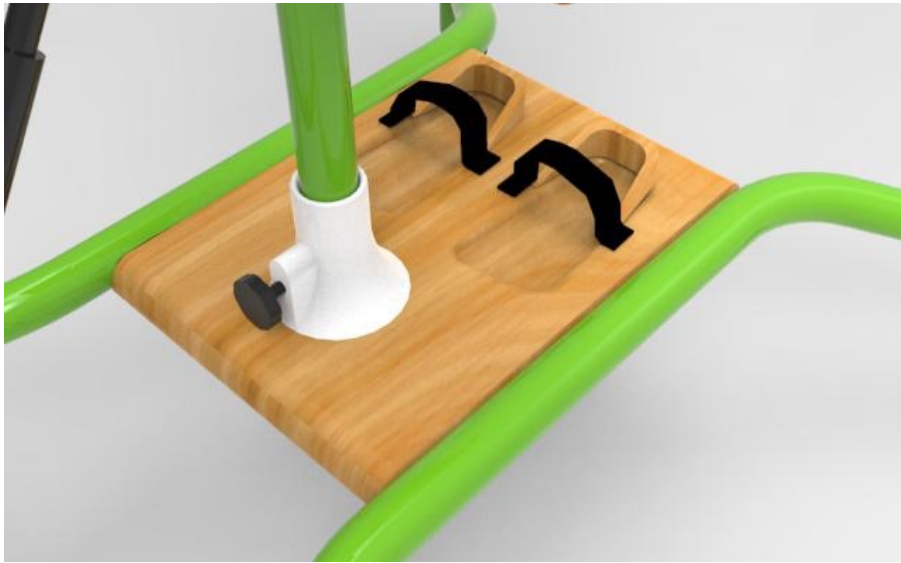












SWOT ANALYSIS	
STRENGTHS	WEAKNESSES
- Children friendly design - Supports Multiple Postures - Stander that looks like a toy - Easy operation - Easy assembly/Disassembly - Adjustable sizes for different sized children - Adjustable angles - Adjustable parts - Modular Parts - Comparatively cheap to the existing models	- Still a bit expensive for the rural India - Needs two persons to operate - No Sideways tilt - Can be designed to further look more like a toy - No outdoor usage - Less maneuverability in Rural places - Needs flat surface for mobility
OPPORTUNITIES	THREATS
- Adjustable foot pedals - Still a Cheaper version - Sideways tilt - Designed to be operated by a single person - Easy usability - Tilt table functionality - More functional wheel design that can be operated on rough floors	- Standers that look even more like a toy - Even cheaper standers - Standers with Sideways tilt - Standers with automation - Products with sideways tilt

8. Short description of the product (elevator speech)

Under-Stand is an inexpensive adjustable special needs stander for children who require support to maintain upright standing positioning.

The angle and adjustability of the supports make the Stander great to use with multiple children in therapy clinics and in schools. It is adjustable to meet the ever-changing abilities of multiple children with special needs.



8.1 Brief Description of the product

The Under-Stand stander will support children with mild to more severe levels of physical involvement.

The stander provides just the right amount of support that each individual requires around the trunk, pelvis and lower extremities. Angle adjustment ranges from 0° to 40° were uniquely factored in to the standing frame to gradually increase weight bearing as his or her tolerance increases. Best of all, the chest plate, flexible lateral supports, knee plate and foot supports are also adjustable and capable of expanding for growth and changing physical/functional levels.

The knee rest, chest pad and the activity tray are attached to the central core tube running from the foot pedal to the top. The foot pedal is attached to the base support.

The Standing System is designed for children as young as 16 months through about 5 years of age. Children love it because it looks playful! Parents and their would love it because it is light-weight and easy to move around.

8.2 Business canvas

Customer Segments :

Under - Stand is a low cost standing frame for children of 16-24 months old with cerebral palsy. It is Intended to be used at Homes, Hospitals, Trusts, Clinics and even Schools. It helps special needs children who require support to maintain upright standing positioning.

Value Proposition:

The main objective behind this project is to provide every special need children with a stander than has all the basic necessary functions such as activity trays and angled system inexpensively. This product tried to eliminate standers that costs sky high at current markets.

Channels:

Under-Stand is a necessary product for daily usage for children with cerebral palsy to help them maintain upright standing position. Government hospitals, NGO trusts and physiotherapy/rehabilitation centres will help people to acquire the product.

Key Resources:

Not many high end resources are required as wood, steel and fabrication is widely available even in rural areas as well as the urban areas.

Revenue Streams:

Even though the product is not designed to generate revenue in mind, the revenue streams would be decided upon the purchasing power of the hospitals, Donations in trusts and the parents themselves. The overall cost would be kept minimum ranging from ₹5000-₹6000.

Customer Relationships:

Since the hospitals and physiotherapy centres understand the product and the patients as they interact with the patient on a regular basis, the product can easily be accepted by the patients.

Key Activities:

The pipes have to be bended and welded, the wood requires hand working if not CNC machine work sheet. All this work can be done locally at fabrication and lathe workshops.

Key Partnerships:

Partnership with the PMR centres would help to reach out to the patients.

Cost Structure:

1. The Steel base and the Steel core - ₹1000
2. Wooden Platform and tray - ₹300
3. Wooden Knee and chest rest - ₹400
4. Cushion x 2 - ₹400
5. Wheels x 4 - ₹900
6. Fabrication - ₹2000

Total cost would be around ₹5000 Approx.

Hospital/Trust Selling cost - ₹5500 if not less.

Profit:

The profit over each stander would be around 10% Approx

8.3 Value Proposition

‘Standing is part of everyday life and CP child is no different’.

Are you sitting down? Perfect. Please take a moment to check in with your body. Is your rear kind of numb? Do the backs of your thighs feel smushed? Is your lower back all crunched? This is your body crying out for help! Really. A wave of new research indicates that sitting all day is actively damaging your health. By forcing a body designed for movement to hold a crushingly immobile position, sitting strains muscles, slows your metabolism,

increases your risk of heart disease, and even shortens your life span.

Now Imagine children with disabilities who cannot stand up or maintain an erect posture. The act of standing is crucial not only for our physical health, but for our emotional and mental health as well. Sitting too much can cause a plethora of health issues, for both able-bodied and disabled individuals. Health complications often arise from the prolonged use of a wheelchair and can include the loss of bone density, lower extremity contractures, spasticity, decreased range of motion, decreased circulation, decreased bowel function, decreased respiratory function, and an increased risk for pressure ulcers and urinary tract infections.

The problem with the standing frames and India is that, The standing frames are extremely expensive while India is an developing country. Cerebral palsy is not so rare as far as India is concerned as about a million cases are reported every year. For Children with this condition stand Because standing is crucial to proper physical and mental function. Therefore the objective of the project is to come up with a design that is inexpensive that has all the basic features and aesthetically pleasing to the child. This inexpensive and innovative standing aid can be of great benefit to children with disabilities, developmental delays and other mobility challenges.

under ^ stand

from the people who care



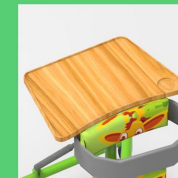
The under - stand is an extremely versatile two-in-one stander, offering prone and upright standing in one product.

The product has a large growth range for kids aged 1 - 5 years and is available with a range of indoor and outdoor mobile bases.

The wide range of adjustability offered by the chest, hip, and knee supports and the head support in Supine provides clinicians with the tools to position a large range of children in the same product.

Colourful, tactile and fun design is ideal for young kids, with attractive age appropriate, machine washable covers, available in different colours.

Lightweight and robust stander support frame can be easily transferred from one chassis to another or disassembled for storage or transportation.



'Standing is part of everyday life and CP child is no different'. By forcing a body designed for movement to hold a crushingly immobile position, sitting strains muscles, slows your metabolism, increases your risk of heart disease, and even shortens your life span.

under ^ stand

from the people who care



Designed and developed at IDC IIT Bombay

Irshath Ahamed K
Industrial Design Centre
IIT Bombay
Maharashtra
400076
9876543210

References

<http://www.leckey.com/pdfs/>

[Clinical Standing Document Nov 2011.pdf](#)

<http://www.rehabmart.com/category/>

[pediatric standers, standing frames and systems.htm](#)

<http://www.livingmadeeasy.org.uk/scenario.php?csid=363>

<http://io9.gizmodo.com/5867716/why-do-humans-stand-upright-its-not-for-the-reason-many-people-believe>

<http://www.readersdigest.co.uk/health/health-centre/how-do-humans-stand-and-balance-without-falling-over>

http://kernodle.duhs.duke.edu/wp-content/uploads/2013/07/Human_Balance_System-1.pdf

<https://ethnomed.org/patient-education/neurological-conditions/cerebral-palsy/>

[A%20Guide%20to%20Undertanding%20Cerebral%20Palsy.pdf](#)

<http://ptjournal.apta.org/content/81/8/1392>

http://www.lifetimecare.nsw.gov.au/_data/assets/pdf_file/0006/15639/

[Wheelchair features supplementary guideline September 25 2012.pdf](#)

http://www.rstce.pitt.edu/rstce_resources/rstce_res_doc/resna_position_on_wheelchair_standers.pdf

http://ac.els-cdn.com/S0304394004014557/1-s2.0-S0304394004014557-main.pdf?_tid=5a5d8174-5137-11e6-a004-00000aacb35d&acdnat=1469321066_77ce7175bb1c4669fcc87bc8f0920357

<https://www.google.com/patents/US20050217025>

<https://www.google.com/patents/US7614639>

<https://books.google.co.in/books?>

[id=wOobDAAQBAJ&pg=PA60&lpg=PA60&dq=standing+frame+study&source=bl&ots=xt-Em04fGC&sig=tPz-AW0aWvG3ub4DJGtJxlajZHs&hl=en&sa=X&ved=0ahUKEwim96js5orOAhXGqI8KHWuuC5o4ChDoAQhOMAk#v=onepage&q=standing%20frame%20study&f=false](#)

http://www.nrrts.org/pdfs/CaseStudies/CaseStudy_PictureWorth.pdf

<http://mobility-india.org/case-study-2/>

<http://uhra.herts.ac.uk/bitstream/handle/2299/3618/903456.pdf;jsessionid=FEA29A29F5AE1FD8F2E71C079DE40C11?sequence=1>

http://www.primeengineering.com/pdf/Symmetry_Bro.pdf

<http://www.incdmtm.ro/mecahitech2011/articole/Pp35-42.pdf>

http://www.leckey.com/pdfs/Clinical_Standing_Document.pdf

https://pure.ltu.se/portal/files/91596530/Birgitta_Nordstr_m.pdf

https://books.google.co.in/books?id=YX8pztQHX0MC&pg=PA405&lpg=PA405&dq=problems+with+pediatric+standers&source=bl&ots=eb4MtlhQKj&sig=-ottMEms7A47oPIu3F7_UG0oDY&hl=en&sa=X&ved=0ahUKEwjjh4bS7_PNAhUIro8KHYwzDbAQ6AEIjAB#v=onepage&q=problems%20with%20pediatric%20standers&f=false

<http://physical-therapy.advanceweb.com/Features/Articles/Supporting-Standers.aspx>

<https://tadpoleadaptive.com/special-needs-standers.html>

<http://www.1800wheelchair.com/category/pediatric-standers/>

https://en.wikipedia.org/wiki/Sense_of_balance

<http://www.medicalexpo.com/prod/drive-medical/product-89641-570581.html>

<https://www.youtube.com/watch?v=Ie2j7GpC4JU>

<http://www.dinf.ne.jp/doc/english/global/david/dwe001/dwe00108.html>

<http://www.infantchart.com/infantlengthage.php>

<http://www.parentree.in/India/Child-Growth-Chart>

<https://deepblue.lib.umich.edu/bitstream/handle/2027.42/172/72118.0001.001.pdf;sequence=2>

http://www.who.int/childgrowth/standards/Technical_report.pdf

Approval

This project titled “Redesign of a paediatric stander” was prepared and submitted by Irshath Ahamed K in partial fulfilment of the requirement of the degree masters in design in Industrial design. It has been examined and is recommended for approval and acceptance.

External Examiner

Internal examiner

Project guide

Chairperson

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources.

I also declare that I have adhered to all the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.

I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Irshath Ahamed K
156130013
IDC School of design
Indian Institute of Technology, Bombay

