DEVELOPMENTAL OF STANDING AID FOR CEREBRAL PALSY CHILDREN

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Abstract

Cerebral Palsy (CP) is a term used to describe a movement and posture problems caused certain activities to be hard and difficult. Anyone who has cerebral palsy may have difficulty in moving the muscles because muscle movements associated with brain problems. Based on information given by doctors and therapists at Occupational Therapy Clinic (OT), UKM, KL they need more equipment to support the CP Childs in their daily life. It is important to encourage them to become more independent. CP child cannot stand up by themselves. They need tools to help them. Parents also face the problem of finding the appropriate equipment for their children. The numbers of equipment’s to accommodate the CP Childs also not much. Furthermore, most of all devices to help children CP imported from abroad and is very expensive. In addition, the design of the existing aid in the establishment of the market, need to be improved. Weaknesses have been identified which are not mobile, the size of the products do not comfort to the patient, and require more manpower to hold the child. Therefore, the standing aid designed is equipped with a set of wheels to facilitate movement and added a seat to help the parents to put a belt to his son sitting in the circumstances. The product have extended into clicking to retain the children from slip or fall out from the seat.

Keywords: cerebral palsy, occupational therapy, standing aid, standing frame,

1.0 INTRODUCTION

Cerebral palsy also known as CP is a condition caused by injury in the parts of the brain that control our ability to use our muscles and bodies. CP in simple word is to describe a problem with movement and posture that makes certain activities become difficult. “Cerebral” means having to do with the brain and “Palsy” means weakness or problems with using the muscles. The brain damage that leads to cerebral palsy can also cause health issues, including vision, hearing, and speech problems, and learning disabilities.

Often the injury happens before birth, sometimes during delivery, or soon after being born. Physical symptoms typically appear in the first few years of life. Infants with cerebral palsy are frequently slow to reach developmental milestones such as learning to roll over, sit, crawl, smile, or walk. CP can be mild, moderate, or severe. Mild CP may mean a child is
clumsy. Moderate CP may mean the child walks with a limp. He or she may need a special leg brace or a cane. More severe CP can affect all parts of a child’s physical abilities. The types of CP are Spastic, Dyskinetic, Ataxic, Hypotonic and Mixed.

There is no cure for CP, but treatment, therapy, special equipment, and, in some cases, surgery can help a child with cerebral palsy. Therefore, this study is carried out to produce a special equipment to help the CP children to stand up by themselves in order to encourage them to be more independent in their daily routine.

A standing frame or stand aid is an assistive technology that can be used by a person who are unable to stand by themselves. Standing can help to stretch out tight muscles and maintain good range of motion. It is especially helpful for tight hamstrings, calves and the muscles at the front of the hips. For children who already have limited range of motion, certain standers can accommodate and work to improve their current range. Standing can help develop trunk and neck control and give children a stable base to develop their reaching and grasping skills. It has been shown to improve general motor skills such as rolling and sitting.

1.1 Statement of the Problem

Based on the information given by doctors and therapists at Occupational Therapy (OT) Clinic, UKM, KL they need more equipment to support the CP Childs in their daily life. This is important to encourage them to be more independent. CP child cannot stand up by themselves. They need an assistive devices to help them. Parents also faced a problem to find a suitable equipment for their child. The number of equipment to accommodate the CP Childs also are very limited. Furthermore, mostly all assistive device for CP Childs is imported from abroad and it is very expensive. The existing standing aid or standing frame need to be improved in the aspect of portable, dismantled, unsuitable product size and manpower required to hold the child in standing position.

1.2 Significant of the Study

This product is designed to help Malaysian CP children with standing disabilities. CP child need help from their parent or special aids to do their daily activities. Increasing age and weight will burden their parents to distract the child. In addition, the existing aids are costly and need be imported from abroad. So, many parents are unaffordable to get the aids for their child.

As stated in the problem statement, the weaknesses of the existing product have been identified and need to be improved. To overcome the problems, the new product should be design which is the product will be added up with stopper, strap and wheel. Stopper also serves as a barrier for child from slipped or fell down. Apart from that, strap will be function as a body supporter and wheels for mobile. Standing aid will help the CP child to stand and training to strengthen their leg muscles. The study aspect in this product including the materials used, ergonomics, product cost and anthropometric.

1.3 Objective

To produce the standing aid for Cerebral Palsy children.
1.4 Scope of Project

The patient sample have been identified a mild CP with the age of 4 years old that cannot stand up by themselves. The information, observation and interview obtained from OT clinic, UKM, KL. A body measurement of the sample has been taken as a guideline to design the standing aid. The material used for making the standing aid is Meranti Wood because it is suitable to make the standing frame. The size of the product were 600mm (length) x 650mm (width) x 1200mm (height).

2.0 LITERATURE REVIEW

Cerebral palsy occurs in 1 in every 300 children according to Children’s Hemiplegia & Stroke Association (2014) and according to Pellegrino (2007) cerebral palsy occurs about 2 to 2.5 out of every 1000 people. Cerebral palsy is a group of problems that effect posture and body movement and also related to a brain injury. Physical problems that occur in patients with cerebral palsy vary from one another. According Vemeda and Jennifer (2012) (Source: Healthline.com) there are five types of cerebral palsy likes spastic, dyskinetic, ataxic, hypotonic and mixed.

a) Spastic: the most common type of cerebral palsy; reflexes are exaggerated and muscle movement is stiff

b) Dyskinetic: dyskinetic cerebral palsy is divided into two categories. Athetoid cerebral palsy which is marked by involuntary, slow, writhing movements and dystonic cerebral palsy where trunk movements are more affected than limb muscles, resulting in a twisted posture

c) Ataxic: voluntary muscle movements are not well coordinated

d) Hypotonic: muscle tone is decreased or floppy

e) Mixed: combinations of the symptoms listed above.

Spasticity in the muscles of one or both legs may affect a person’s ability to

a) Stand upright

b) Sit upright

c) Transfer from one position to another

d) Move and reposition in bed

e) Walk and run

According to Werner (2009), the child who is ‘spastic’ has muscle stiffness, or ‘muscle tension’. This causes part of his body to be rigid, or stiff. Movements are slow and awkward. Often the position of the head triggers abnormal positions of the whole body. The stiffness increases when the child is upset or excited, or when his body is in certain positions. The pattern of stiffness varies greatly from child to child that effect on the upper limbs (arms and hands). Figure 1 shown a typical spastic positions. Spasticity in these areas can lead to difficulties with tasks involving the hands and the arms:

a) getting dressed

b) washing and toileting oneself

c) eating or drinking

d) writing

e) manipulating objects
2.2 Standing Frame

According to Goktepe; Tugcu; Yilmaz; Alaca; Gunduz (2008), a standing frame also known as a stand, stander, standing technology, standing aid, standing device, standing box, tilt table is assistive technology that can be used by a person who relies on a wheelchair for mobility. A standing frame provides alternative positioning to sitting in a wheelchair by supporting the person in the standing position. Many children who have problems with balance or control for standing may benefit from standing or playing in a 'standing aid'. Even for the child who may never stand or walk on her own, being held in a standing position with weight on her legs helps circulation and bone growth and strength (Werner, 2009). Many children with cerebral palsy stand and walk in strange positions. A child’s unsure balance often increases the uncontrolled tightening of certain muscles and makes balance even more difficult. The child who cannot yet stand alone can be placed in a standing frame for about an hour each day. Even for the child who may never stand alone or walk, standing in a frame helps prevent deformities. It also helps the leg bones grow and stay strong.

2.3 Spinal Cord Injury

Standers used by people with both paraplegia and quadriplegia since a variety of support options are available to accommodate for mild to severe disabilities. Bone mineral loss and osteoporosis are common consequences after spinal cord injury. Therapeutic standing, a weight-bearing intervention that can be applied using a standing frame, has traditionally been incorporated into rehabilitation programs for those with chronic spinal cord injury in order to prevent osteoporosis. A systematic review of the literature conducted by Biering-Sorensen, Hansen, and Lee, (2009) shows that therapeutic standing in the chronic phase of injury, defined as one year after injury, has no effect on maintaining bone density. Results on the effectiveness of therapeutic standing during the first year of injury are conflicting and show that shorter, less aggressive intervention is less effective. If therapeutic standing is to be incorporated into treatment, it should be more aggressive and initiated in the early stages of injury if any beneficial impacts on bone mineral density are hoped to be achieved.
2.4 Seat Surface

According to Wright-Ott and Egilson (2011) seat surface may be planar, contoured or custom moulded. A planar surface is flat and must more appropriate for those requiring any minimal support. Contoured seating conforms to the shape, buttocks and thighs and allowing the body to have more contact with the seating surface and providing increased support and control. Custom moulded seating for the severely affected individual to accommodate fixed and provide comfort. The base of seat and backrest must be moulded.

2.5 Backrest and Backrest Inclinations.

This can be used to gradually bring a child to a standing position. It is especially useful for older children who get dizzy if stood up straight too quickly. This can happen after a spinal cord injury or a long, severe illness. The child can be stood up gradually and for longer each day (Werner, 2009). Postural control of sitting in children with cerebral palsy can be enhanced by inclination of the seat surface (Myhr and Von Wendt, 1991). Seeger, Caudrey and O’Mara NA (1984), investigated the effect of variations in seat angle with a vertical backrest on hand function of children and young adults with cerebral palsy. This study evaluated function whilst the hip was tilted 15° posterior and interior with a vertical backrest.

2.6 Pelvic Straps

According to Izzat, Farid, Zahid, Nurhidayah and Mohamad (2013) pelvic straps can prevent the child from standing or extending out of the seat and for safety purposes. The pelvic strap to provide additional pelvic stabilization, to support the pelvis in a neutral or anterior tilted position and prevent forward sliding in the seat. In research studies by Myhr and Von Wendt (1990) in their investigation to find a functional sitting position for children with cerebral palsy. They found that a hip belt at 45° angle to prevent the child from sliding. Apart from that, this strap serves to hold or restrain the child's body from falling. This strap as a safety device that must be applied when creating any aids for children with cerebral palsy.

2.7 Meranti wood.

The timber is a Light Hardwood with a density of 415-885 kg/m³ air dry. The standard graveyard tests on untreated specimens carried out by the Forest Research Institute Malaysia (FRIM) have classified *dark red meranti* as moderately durable with an average service life ranging from about 2.0 years (*S. singkawang*) to 3.9 years (*S. platyclados*). For the species *S. curtisii*, *S. pauciflora*, *S. platyclados* and *S. acuminata*, the heartwood is classified as moderately durable (with an average service life of 2-5 years). The sapwood of *dark red meranti* is susceptible to dry-wood termite attacks, which may eventually spread to the heartwood. However, an initial invasion of the heartwood is less likely to occur. Untreated timber of *S. curtisii* was only slightly attacked by marine borers after eight months submergence at Port Klang (Thomas, 1933).

The timber is suitable for joinery, furniture, high class interior finishing, flooring, decking, panelling, partitioning, mouldings, skirtings, fancy doors, door and window frames and sills, staircase (angle blocks, rough bracket and tread), plywood, railway sleepers, posts, beams, joists, rafters, pallets (expendable type), vehicle bodies (framework, floor boards and planking), ship and boat building (keels, keelsons, framework and general planking), cooling tower (non structural members) and other light constructional works. Table 1 shown strength properties of meranti.
<table>
<thead>
<tr>
<th>Species</th>
<th>Test Condition</th>
<th>Modulus of Elasticity (MPa)</th>
<th>Modulus of Rupture (MPa)</th>
<th>Compression parallel to grain (MPa)</th>
<th>Compression perpendicular to grain (MPa)</th>
<th>Shear strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. acuminata</em></td>
<td>Green</td>
<td>10,500</td>
<td>54</td>
<td>27.4</td>
<td>2.41</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Air dry</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>S. curtisii</em></td>
<td>Green</td>
<td>12,800</td>
<td>69</td>
<td>36.3</td>
<td>3.86</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Air dry</td>
<td>13,900</td>
<td>90</td>
<td>45.4</td>
<td>5.03</td>
<td>8.0</td>
</tr>
<tr>
<td><em>S. pauciflora</em></td>
<td>Green</td>
<td>12,700</td>
<td>71</td>
<td>37.7</td>
<td>3.45</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Air dry</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>S. platyclados</em></td>
<td>Green</td>
<td>11,300</td>
<td>58</td>
<td>30.0</td>
<td>2.69</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Air dry</td>
<td>12,100</td>
<td>77</td>
<td>39.6</td>
<td>4.14</td>
<td>8.7</td>
</tr>
<tr>
<td><em>S. singkawang</em></td>
<td>Green</td>
<td>10,100</td>
<td>55</td>
<td>31.8</td>
<td>3.03</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>Air dry</td>
<td>11,200</td>
<td>74</td>
<td>38.8</td>
<td>2.97</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Source: MS 544:Part 2:2001

2.9 PVC Leather.

PVC leather exists in a variety of household items, including toys, furniture, and clothing. Frequently called leather or vinyl, the material produces shiny clothing in bold, vibrant colours. Before purchasing clothing made from PVC leather, consumers should understand the construction of the material, the differences between it and other faux leather materials, and care instructions.

3.0 METHODOLOGY

These present study had been conducted at Occupational Therapy Clinic (OT), UKM, Kuala, Forest Institute of Malaysia (FRIM), Furniture Technology Center Industry (Fitec) and Malaysian Timber Industry Board (MTIB) to gather an information about the patient sample’s and product design.

3.1 Identifying the sample.

The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behaviour by epilepsy and by secondary musculoskeletal problems. The patient sample’s is a boy, 6 years old and have a spastic (mild) CP. He is unable to stand up on his own.
3.2 Development of Prototype.

According to Goktepe; Tugcu; Yilmaz; Alaca; Gunduz (2008), a standing frame also known a stand, stander, standing technology, standing aid, standing device, standing box, tilt table is assistive technology that can be used by a person who relies on a wheelchair for mobility. A standing frame provides alternative positioning to sitting in a wheelchair by supporting the person in the standing position. Many children who have problems with balance or control for standing may benefit from standing or playing in a 'standing aid’. Figure 2 shown the development of prototype

![Diagram](image)

3.2.1 Identify problem and generating idea.

The problem on existing standing aid are cannot be slanting, cannot be dismantled, not portable and the size on suit on patient. Moreover, parents also have trouble putting on a belt to CP children. Therefore, the idea was generated to makes the standing aid from sitting to standing. This will help parents to put the belt on the children before stand upright.

3.2.2 Sketch design process

Sketching is the first step in order to get the product design.

![Figure 2: Sketch design of standing aid.](image)

3.2.3 Measurement process

For the measurement process, a sample size of children who suffered spastic cerebral palsy has been taken. The measurement of whole body of the child has been used as a guidance to make the standing aid. The data collected is shown table 1.

<table>
<thead>
<tr>
<th>Bil.</th>
<th>Description</th>
<th>Measurement(mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Height</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>Chest</td>
<td>240</td>
</tr>
<tr>
<td>3</td>
<td>Height neck to head</td>
<td>190</td>
</tr>
<tr>
<td>4</td>
<td>Waist</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>Seat</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>Length leg</td>
<td>550</td>
</tr>
</tbody>
</table>
3.2.4 Material preparation

Before making a product, suitable material is selected and it safe to use. The material used in production of standing frame is Meranti wood, plywood, PVC leather, foam, betting, screws, drawer slide folding bracket, wheel, sandpaper, belt strap, sealer and clear.

3.2.5 Cutting process

In this process, the machines used table saw, arm saw, ripsaw and drill. Table 2 show the cutting list for making the standing aid.

Table 2: Cutting list

<table>
<thead>
<tr>
<th>BILL SHEET OF ONE No.</th>
<th>BILL OF MATERIALS</th>
<th>SHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part No.</td>
<td>Part per Article</td>
<td>Part Name</td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>BACK REST</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>SEAT</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>PILLAR</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>LONG BASE</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>SHORT BASE</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
<td>SIDE SUPPORT</td>
</tr>
<tr>
<td>G</td>
<td>4</td>
<td>SIDE LONG BASE</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>BACK LEG</td>
</tr>
<tr>
<td>I</td>
<td>4</td>
<td>SIDE FEET</td>
</tr>
<tr>
<td>J</td>
<td>2</td>
<td>FEET</td>
</tr>
</tbody>
</table>

3.2.4 Material preparation

3.2.5 Cutting process

4.0 RESULT

4.1 Result

A standing aid or standing frame is an assistive devices that can be used by a person who are unable to stand by themselves. It help the CP children to train their leg muscle. The new standing aid designed can be used in sitting position before fixing up the children to be stand. Thus, parents can handle their child and the product itself. This product also will add up a number of assistive devices in local market because there are less manufacturer involved. Lastly, the feedback given by the parents and therapist stated that the standing aid is suitable to be use at home and medical centre as one of the treatment devices.
4.2 Advantages of Product

i. 2 in 1 concept which is sitting and standing in one designed.
ii. Finishing’s used were non toxic and odourless type.
iii. Foam used covered with leather for patient’s comfortable and easy to clean
iv. Straps locked for safety.
v. Easily handled and mobile.
vi. Low cost product.

Figure 3: New Standing Aid design

Figure 4: Product tested to the end-user

Figure 5: Existing design in the oversea market

Figure 6: Existing design in the local market (sources from MyCP Malaysia)
5.0 DISCUSSION AND CONCLUSION

The result obtained is expected to achieved the objective and solve the problem which is the Cerebral Palsy children cannot stand up by themselves. They need an assistive device to help them.

Some of the characteristic is still maintained, for example, using plywood as the frame of the seat. The base of the product used solid wood because it is stable. So, it was difficult to collapse. The product attach with wheel at the base of the standing frame to eliminate the mobility problem.

Besides, the standing frame is equipped with footrest for child to rest their foot. The wide straps should also be added at the child’s chest area for the purpose of safety and child therapy because when the child is sit on the seat at normal position, its afraid that the child body is bend forward causing the child to fall.

The standing aid can help parents and therapists to fitting up their children because the product starts from sit and then can stand. So parent cannot face the problem when strap the belt to the child.

5.1 Conclusion

From this study, it can be concluded that standing aid for children Cerebral Palsy have been produce successfully. Besides, there are several thing need to be highlighted. Design should be improve from the aspect of adjustable like can be slanting and dismantle. This caused the standing aid is big, so this product should be made so as to be separated to make it easier to bring into the car. Further study is needed to enhance the design. Neck support should be added into the design in order to help them. Other than that, the standing frame should be added the table for child to do some activities. The design should be more interesting and innovative so that the children more interested to use it.

Recommendations from Dr. D zalani and Mr. Mohammad Sharul Hafezz of HUKM who are experts on the therapy provided some improvements to the product of which is, need to add support at the knee so that the load of CP children does not depend entirely on the stopper. Then, it is to prevent children CP knee to be bent while standing. The support in the hip belt is also necessary to use a slightly larger to give comfort to the children as well as safety while in a standing position. Lastly, support for the neck should also be placed because a CP child's neck is weak and flexible down. So, at least one support should be added.
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