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**EFFECT OF VIRTUAL REALITY IN SPIDER CAGE**  
**ON GROSS MOTOR PERFORMANCE AND BALANCE**  
**IN CHILDREN WITH SPASTIC DIPLEGIA**

**Thesis Submitted**

By

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# CHAPTER I

## INTRODUCTION

Cerebral palsy (CP) is a nonprogressive motor impairment syndrome caused by brain defects or lesions that occur in an immature brain before or during birth or within two years of birth (1).

It is accompanied by motor disorder; disturbances of sensation, cognition, perception, communication, and behaviour; and seizure disorder and affects overall development (2,3).

Accordingly, children with CP show reduced postural control when engaging in several activities such as sitting, standing, and walking and have limitations in performing the activities of daily living (4,5).

Therapeutic approaches for CP include neurodevelopmental treatment, Vojta therapy, sensory integration therapy, and conductive education. Specific therapeutic strategies for CP may differ, but they all aim to improve the independence of children with CP (6).

Considering that the rehabilitation period of patients with CP is observed in a prolonged period of time, it is important to induce the sustained participation of these patients, making sure that the therapeutic interventions are interesting and easily performed (7). For this we will use this treatment tools in our study.

Spider therapy is an intensive treatment approach which was originally developed in Poland. It involves suspending the child in the Centre of universal exercise unit by using a number of elastic bungee cords of different elasticity, these cords are attached to specific points on special belt around the child's waist, forming a unique spider web around the child which provides them essential support (8).

Virtual reality gaming augments a desirable motor processing skills through task-driven training and also encourage problem-solving. With a higher

concentration and engagement of goal-driven games, the virtual reality gaming might influence the cognitive-motor planning of children with CP (9).

In the past, traditional neurophysiological approaches and novel emerging rehabilitation strategies addressed the gross motor function and balance capacity of children with CP (10).

Recommended that the group therapy, goal-directed motor practice, strengthening exercises, treadmill training, balance and walking training were beneficial for functional mobility of children with CP. In recent times, technological advancement has gained momentum in developing strategies for limb recovery and balance capacity of the paediatric and adult population with brain dysfunction (11).

## **Statement of the Problem**

This study will be conducted to answer the following research question: Is there any significant effect of virtual reality and physiotherapy in spider cage on gross motor performance and balance in children with spastic diplegia?

## **Purpose of the Study**

This study will detect the effect of virtual reality in spider cage on gross motor performance and balance in children with spastic diplegia.

## **Significance of the Study**

The current study will be directed to investigate effect of virtual reality on gross motor and balance as the weakness of the trunk muscles and lower limb muscles along with spasticity potentially predispose balance and walking issues of children with bilateral spastic CP (12).

The balance deficits in children with CP are multifactorial. According to the system's model proposed by Woollacott and Shumway-Cook, multiple

systems contribute to postural dysfunction in children with CP. Muscle weakness and stiffness of lower limb muscles account for biomechanical constraints and postural malalignment during standing and functional balancing (13).

Virtual reality is one of the novel technology-based approaches to treat balance and motor function in children with CP. It utilizes the interactive simulations created in computer hardware and software, in which the children find opportunities to engage in environments appearing real to them (14).

After reviewing the available previous published studies, it was found that there is no previous study directly compared between the effects of virtual reality and physical therapy in spider cage on gross motor performance and balance with diplegic children CP children. Both therapeutic modalities were found to induce good clinical outcomes when studied separately, so this study will be conducted to examine the effectiveness of virtual reality.

The greater demand for physical therapy for Paediatrics' signifies the need for more effective, safer and evident therapeutic modalities. The findings of this study will help both; the therapists and the children to save time, effort and reach the best results in concise times.

## **Delimitations**

This study will be delimited to:

- 30 children with spastic diplegia with age range from 6 to 12 years are enrolled in the study.
- Children will be randomly allocated into two equal groups; Group A will receive virtual reality and physiotherapy, while Group (B) will receive physiotherapy alone.
- All children will receive three sessions per week for twelve weeks.
- Variables will be evaluated pre and post treatment for all child.

- Gross motor performance will be evaluated using Gross Motor Function Measure 88 (GMFM-88).
- Balance will be evaluated using Pediatric Balance Scale (PBS).

## **Hypotheses**

This study will test the following hypothesis:

There will be no significant the effects of virtual reality on gross motor performance and balance in children with spastic diplegia.

## **Basic Assumptions**

It will be assumed that:

1. Assessment tools are valid and reliable.
2. The participants will be cooperative during evaluation and treatment.
3. All children will recognize and follow verbal order included in both testing and training techniques.
4. Both genders will participate in the study.

## **CHAPTER II**

### **LITERATURE REVIEW**

The goal of the study is to see effect of virtual reality and physiotherapy in spider cage on gross motor performance and balance with diplegic children. This study reviews the following related titles as follows:

- 1. Cerebral palsy.**
- 2. Spastic diplegia.**
- 3. Virtual reality.**
- 4. Gross motor performance.**
- 5. Balance.**
- 6. Gross Motor Function Measure 88 (GMFM-88).**
- 7. Pediatric Balance Scale (PBS).**

#### **1. Cerebral palsy**

##### **A. Definition**

Cerebral palsy (CP) refers to a group of disorders caused by faulty development or damage to motor areas in the brain that disrupts the brain's ability to control movement and posture (15).

Cerebral palsy refers to a group of posture and movement disorders occurring as a result of a non-progressive lesion of the developing central nervous system. This damage to the immature brain leads to problems with balance, coordination, and movement (16).

Cerebral palsy is a motor impairment syndrome, which is a result of non-progressive insults or anomalies in the early brain development period (17).

## **B. Etiology of Cerebral palsy**

### **Prenatal period:**

Prenatal period causes may be viral infections, radiation exposure, congenital brain malformation, problem of placental malfunctioning and maternal disorder (18).

### **Perinatal period:**

Perinatal period causes may be pre-eclampsia, asphyxia or anoxia, trauma, intra-ventricular hemorrhage and respiratory disorders of prematurity, neonatal causes are infection, acute metabolic disorders and blood incompatibility (18).

### **Post-natal period:**

Postnatal causes include head injury, infection, viral and bacterial meningitis, encephalitis, cardiovascular accident, malnutrition and toxins (14). Post-natal causes may be traumatic head injury, viral and bacterial meningitis, anoxia and toxins (18).

## **C. Classifications**

Spastic-type CP is the most common type, comprising 85%-91% of all CP cases. Dyskinetic CP, which includes athetosis and dystonia, comprises 4%-7% of cases, whereas ataxic CP and hypotonic CP constitute 4%-6% and 2%, respectively (19). Spastic CP is further sub-classified into hemiplegia (38% of all spastic CP cases), diplegia (37%), and quadriplegia (constituting 24%). Thus, out of all the subtypes, hemiplegia is the most widely seen presentation in children with CP (19).

## **2. Spastic diplegia.**

Children with spastic Cerebral Palsy (CP) have smaller and weaker muscles than healthy children. Muscle strength correlates with gait and motor

function and strength is more highly related to function than spasticity. Spastic muscles respond positively to strength training and strength gains have been shown to be similar or greater than those reported in the healthy population (20). Various studies have reported significant improvements in gait following strengthening programmes in terms of temporal parameters and Gross Motor Function Measure (GMFM) Dimension E (21).

McPhail and Kramer found a direct correlation between the strength gained and functional improvement, but significant changes in gait kinematics following strength training appear difficult to achieve and have rarely been reported (22).

These strengthening studies, however, presume weakness is present, and reports specifically documenting the extent and distribution of muscle weakness in children with CP remain very limited. In Spastic Diplegia (SD), the most prevalent diagnostic category of CP, muscle strength has been quantified at the knee joint, and two lower limb strength profiles have been undertaken and compared with controls (23).

### **3. Virtual reality (VR).**

Virtual reality is one of the novel technology-based approaches to treat balance and motor function in children with CP. It utilizes the interactive simulations created in computer hardware and software, in which the children find opportunities to engage in environments appearing real to them (24).

The children get constant feedback about the movement and posture of their body in virtually immersive and non-immersive conditions that are conducive to motor learning (25).

VR is reported to augment the desirable motor performance because of brain plasticity and brain reorganization through active participation, receiving feedback, and repetition of movements (26).



VR increases the exercise compliance level in achieving selective motor control and enhances conventional physiotherapy effectiveness (27).

Luna-Oliva et al<sup>10</sup> showed improvement in the motor and processing skills, balance, gait speed, running, jumping, and manual dexterity in children with CP after 8 weeks of VR intervention. VR combined with physiotherapy appears to be a promising new treatment approach with wider future applications. Research over the past decade using VR intervention has reported benefits to children with CP. VR may assist children in acquiring new motor skills, sustaining the benefits from exercise, and enabling children to use their hands for more functional skills. If this is indeed, the case the combined approach may have the potential to greatly enhance the abilities of the child, improving independence alongside minimizing secondary implications associated with growth and development (28).

#### **4.Gross motor performance.**

The impairment in CP, including secondary impairments such as spasticity, muscle contracture, bone deformity, muscle weakness, and coordination disorders, is multifactorial and primarily affects the lower extremities, such as deficits in walking ability (29).

The varying levels of impairment affecting children with CP can be described according to the Gross Motor Classification System. Physical inactivity in children with CP increases the risks of secondary problems such as pain, depression, social isolation, fatigue, pressure sores, and mobility limitations. Children with CP suffer from motor and cognitive disabilities, which usually require a long-term, multifaceted, and multidisciplinary approach (30).

Children with CP also tend to have lower endurance, muscular strength, and cardiorespiratory fitness than the general population. The consequences of chronic muscle imbalance and the resultant deformities can cause increasing disability with age. One of the most significant problems faced by children with

CP is defective postural control. Maintaining postural control, which is required to perform activities of daily living, is often a major challenge for children with CP (31).

## **5.Balance.**

Spastic diplegia, the most prevalent type of CP, is characterized by a wide range of ambulatory outcomes. It affects bilateral lower extremities more than upper extremities in most cases. As a result, walking function and corresponding balance control are impacted (32).

Balance control is important in the performance of most functional skills. Postural balance control in children with CP deteriorates as compared to typically developing children, most likely due to slowed and impaired development of neural motor control mechanisms together with the common secondary musculoskeletal abnormalities (33).

Balance control plays a central role in the motor dysfunction in children with spastic diplegic cerebral palsy. Reduced ability of children with spastic diplegia to adapt the sensory and motor components of postural control to changing task and environmental demands affects their proper response to balance disturbance, the recovery from unexpected threats to stability that refer to reactive balance control, functional deficits and the subsequent limitations in mobility. The amount of time required to recover stability following a balance threat (time of stabilization) and the mean area of centre of mass (COM) displacement per second during balance recovery are increased in these children (34).

Due to poor postural control, the delineation “walking by falling” is especially true for children with CP. A heightened fear of falling can also lead to restriction of activities. Although not all falls can be prevented, those due to poor postural control can be reduced by improving balance performance (35).

Falls may result in pain, injury and disability, and individuals may lose confidence in their ability to perform routine activities. Because a relation has been established between constraints on balance control and functional limitations in children with CP, increased efficiency of postural balance control may be necessary for them to facilitate functional performance (36).

Therefore, many researchers have suggested that balance training should be a crucial component of any rehabilitation program for these children. Such training can modify postural balance control by modulating the amplitude of muscle activities and speeding recruitment of the postural muscles (37).

While there are many easy-to-use functional scales for assessing posture balance control, advanced laboratory systems provide more detailed information on both static and dynamic balance. The balance platform is commonly employed in balance analysis laboratories for assessing postural balance with regard to oscillations from the centre of pressure in the anterior-posterior and medial-lateral directions (38).

## **6. Gross Motor Function Measure 88 (GMFM-88).**

The GMFM is used by a variety of rehabilitation specialists for clinical and research purposes to measure change over time, and the effectiveness of interventions to affect change (39).

The standardized measures provide objective information in an easy-to-understand format. As stated earlier, the GMFM has become the standard tool for measuring change in gross motor function over time for children with CP. Given its unique purpose, its wide use, and the amount of research that has been conducted using this outcome measure, examining the usefulness as related to intervention is important to measure change over time for children with CP. The Gross Motor Function Measure (GMFM) and its subsequent revisions, has become the most common functional outcome measure used by rehabilitation specialists to measure gross motor functioning in children with CP and other

neurologically based conditions, such as Down syndrome and traumatic brain injury (40).

This tool showed high validity at 0.91 when applied, the GMFM-88 was reported to be a useful method for measuring gross motor function in children with CP because of its high reliability, with inter-rater reliability of 0.77, test–retest reliability of 0.88, and intra-rater reliability of 0.68 (41).

## **7. Pediatric Balance Scale (PBS).**

The PBS is a standardized tool for testing balance. this tool developed by modifying the Berg Balance Scale to test the functional balance of the school-age population with mild-to-moderate motor impairment. The tool has been confirmed to be reliable in terms of both intra-rater reliability (intraclass correlation coefficient (ICC) = 0.99) and inter-rater reliability (ICC = 0.99). The items can be measured within 15 min and do not require the use of specialized equipment (42).

## **CHAPTER III**

### **SUBJECTS, MATERIALS, AND PROCEDURES**

#### **I. Subjects**

The current study will target children with spastic diplegia. Patients will be recruited, for convenience, in three physiotherapy clinics. The study will include three governmental hospitals at Kafr-Elsheikh governorate and El bouhira, comprising desouq general hospital, shubrakhit general hospital, and Pediatric Out-patient Clinic of Faculty of Physical Therapy, Kafr-Elsheikh University.

#### **Sample size calculation:**

Using G-power version 3.1.9.7 for windows and regarding t-test study, alpha level of 0.05, confidence interval 80% and effect size of 1.135 calculated from the previous study of Krishna et al. (43), the total sample size will be 28 children (fourteen in each group), (Figure 1). We will increase number to be 30 children (Fifteen in each group) to avoid any drop out.

To avoid selection bias, the children will be randomly allocated by simple random method via choosing one of two wrapped cards representing the two treatment groups, which are:

- Group (A): will receive virtual reality in addition to the traditional exercise program.
- Group (B): will receive traditional exercise program.

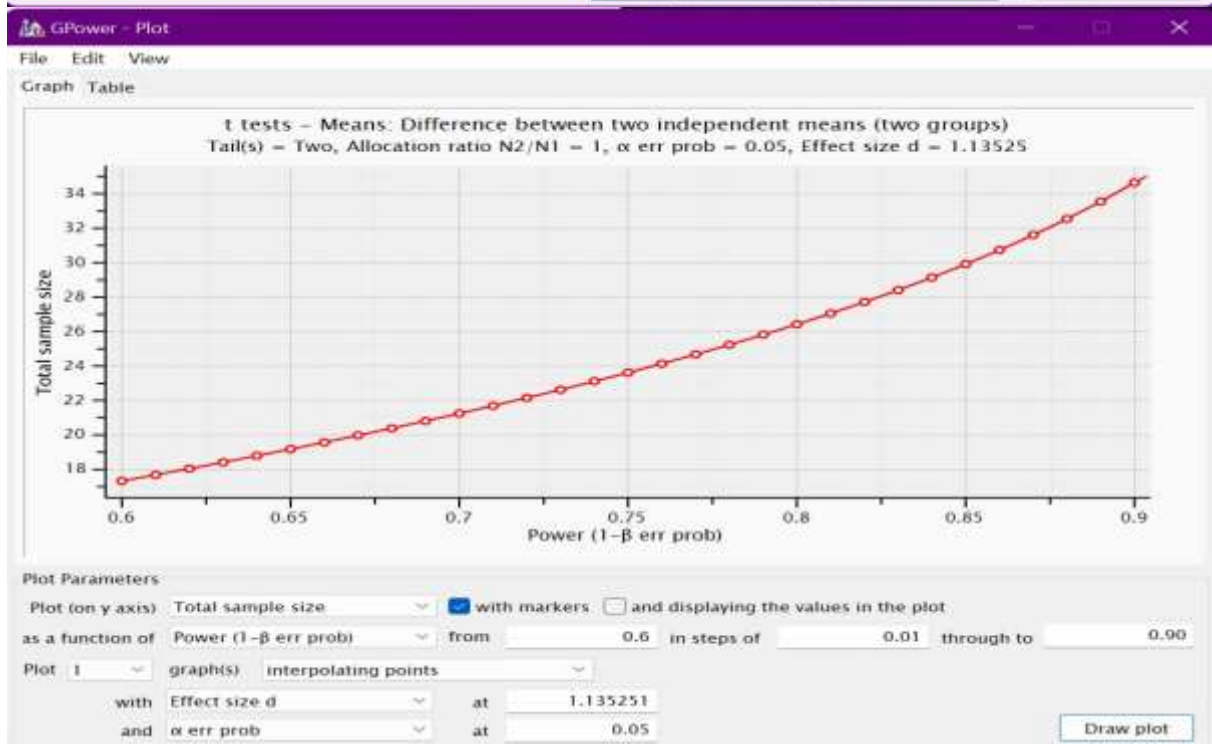
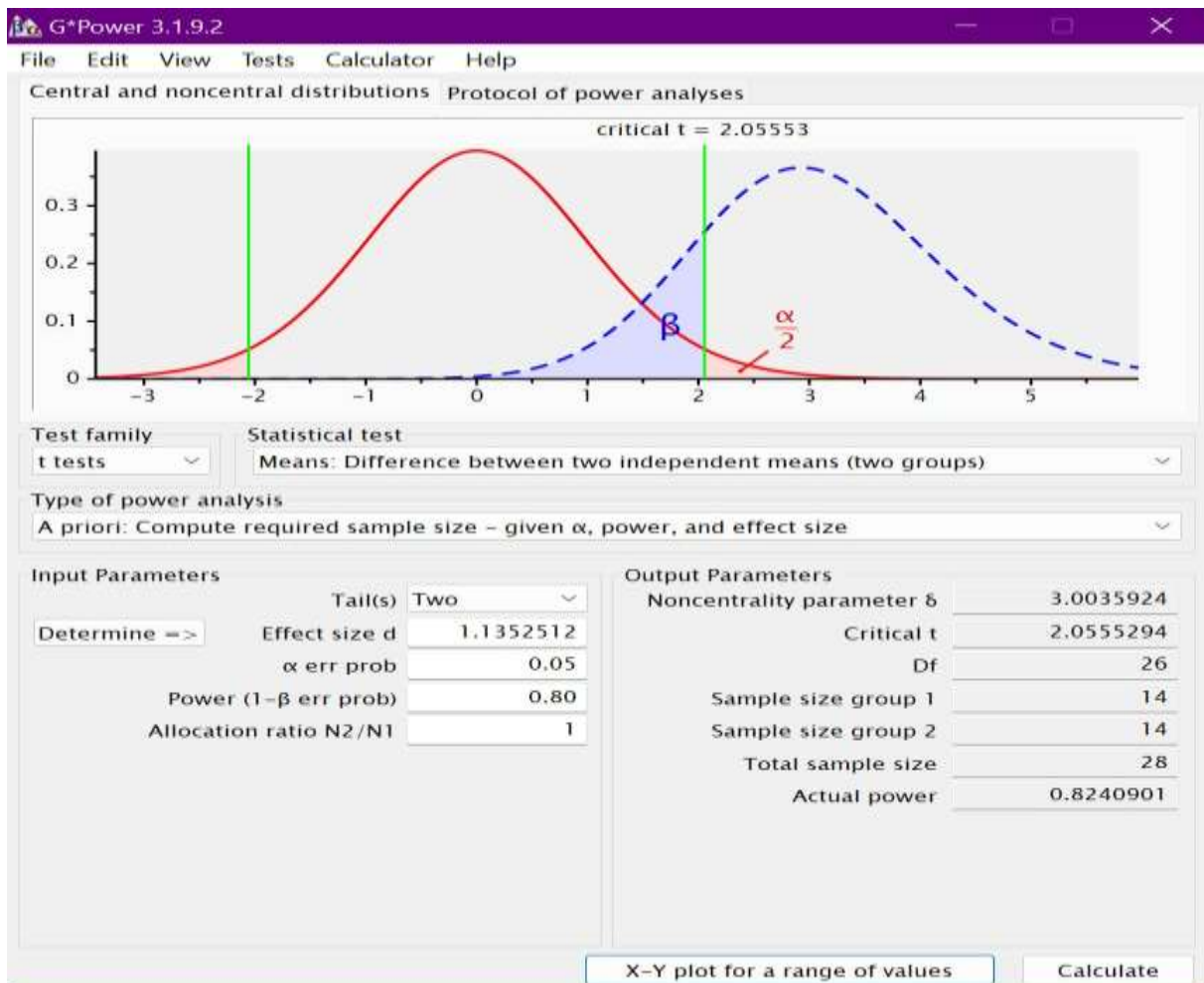


Figure 1: Sample size calculation in G-power software program.

## **Inclusion criteria:**

Children will be included in the study if they fulfil the following criteria:

1. A medical diagnosis of spastic diplegic CP made by pediatricians or pediatric neurologists.
2. Children with spasticity grades ranged from 1 to 2+ according to Modified Ashworth scale (MAS).
3. Their age range from 6 to 12 years.
4. Children who can sit on the chair with good balance and recognize and follow verbal orders and commands included in both testing and training techniques.

## **Exclusion criteria:**

Children with a permanent spastic diplegia, who might have one or more of the following, will be excluded:

1. They had a permanent deformity (bony or soft tissue contractures).
2. Children having visual or auditory defects.
3. Current hospitalization for urgent medical reasons.
4. Severe mental retardation.
5. Children who will undergo fewer than twelve regular sessions of physical therapy at their place will not be included in the survey.
6. Children with history of epileptic seizure or any diagnosed cardiac or orthopedic disability that may hinder assessment methods and treatment.

## **Ethical consideration**

The study's protocol will be reviewed and approved by the Research Ethical Committee, Faculty of Physical Therapy Kafrelsheikh University.

## **Assessment instruments**

1. . Modified Ashworth scale: to measure the degree of spasticity to enroll children in the study, **Appendix I**.

2. Gross Motor Function Measure 88 (GMFM-88) to measure Gross motor performance. **Appendix II.**
3. Pediatric Balance Scale (PBS) to measure Balance. **Appendix III.**
4. Virtual reality glasses (figure 2).
5. Smart display.
6. Spider cage for suspension (figure 3).
7. Smart phone for virtual reality games.



**Figure 2: virtual reality glasses**

## **Procedure**

### **A. Patients preparation**

1. To start the treatment program, an agreement will be taken from the manager of the outpatient clinics, Faculty of Physical Therapy Kafrelsheikh University.
2. To provide safe and effective treatment, all interventions, evaluation and recording of all measurements at the beginning and at the end of the study will be performed by the primary investigator (the same therapist).
3. All the children parents fitted the inclusion criteria, will be given explanation of the treatment protocol in their understandable language and



they will allow their children to participate after signing a consent form, Appendix IV.

4. All the children demographic and outcome measures data will be collected in especially well-designed sheets, (Appendix V) and (Appendix VI).

## **B. Assessment procedures**

### **1. Evaluation of gross motor performance using GMFM-88:**

The Gross Motor Function Measure (GMFM) 88 will be used to determine the severity of each case and to assess the child's motor performance in five dimensions: lying and rolling (17 items); sitting (20 items); crawling and kneeling (14 items); standing (13 items); and walking, running, and jumping (24 items). All items will be checked and scored before interpretation of child's performance in each dimension. Scores of each dimension will be expressed as percentage of maximum scores for that dimension. Total score will be obtained by averaging percentage scores across the 5 dimensions. Individual dimensions of GMFM-88 can be administered depending on the child's current level of function (41).

### **2. Evaluation of balance using Pediatric Balance Scale (PBS):**

The PBS is a standardized tool for testing balance. The items can be measured within 15 min and do not require the use of specialized equipment. The Pediatric Balance Scale is a modified version of the Berg Balance Scale that is used to assess functional balance skills in school-aged children. The scale consists of 14 items that are scored from 0 points (lowest function) to 4 points (highest function) with a maximum score of 56 points (42).

## **C. Treatment procedures:**

### **1. Treatment protocol in Group A, virtual reality protocol:**

- A specialized VR glasses will be used and VR games application.

- Smart phone used can screen mirroring to lcd display.
- During use of VR glasses therapist observe what child do in the game.
- The child stands in the spider cage at treatment period (figure 3).
- Use 360-degree video.
- The treatment duration will be 30 minutes.
- The treatment protocol will be repeated 3 times per week for 12 weeks.



**Figure 3: spider cage**

## **2. The traditional exercise program (given to both groups):**

- The training program of gross motor performance:

All the tests in gmfm 88 will be used as a treatment program and exercises such as basic rolling, sitting, crawling and walking.

- The selected physical therapy program:

1. Neurodevelopmental approach: aims to facilitate typical motor development and function and to prevent secondary impairments (figure 4).

2. Approximation: aims to control spasticity and stimulate the joint mechanoreceptors (figure 5).

3. Stretching exercise: aims to maintain length and flexibility of shorten muscles (figure 6).

4. Strengthening exercise: aims to improve the functional ability (figure 7).

5. Spider suspension exercise for 30 minutes (figure 8).
5. Gait training activities: aims to improve balance (figure 9).
6. Balance training program: aims to improve balance (figure 10).
  - The treatment protocol will be repeated for 12 weeks.



**Figure 4: Neurodevelopmental approach**



**Figure 5: Approximation**



**Figure 6: Stretching exercise**



**Figure 7: Strengthening exercise**



**Figure 8: Spider suspension exercise**



**Figure 9: Gait training activities**





**Figure 10: Balance training program**

### **Data collection and statistical analysis:**

Data of all children in both groups will be collected and include:

1. Name, serial number and age (years).
2. gross motor performance pre- and post-treatment with GMFM 88.
3. balance pre and post treatment with PBS.

#### **B. Statistical analysis**

For testing the study hypotheses, the following statistical methods will be used:

1. Descriptive statistics (mean and standard deviation) of the demographic data of all patients in both groups.
2. The suitable statistical tests will be used according to the nature of the collected data.
3. Level of significance for all tests will be set at  $p\text{-value} \leq 0.05$ .
4. The statistical package for social sciences (SPSS) version 26 for windows (Armonk, NY: IBM Corp) will be used for data statistical analysis.

# APPENDICES

## Appendix I

### Modified Ashworth Scale

# MODIFIED ASHWORTH SCALE

| Score | Ashworth Scale (1964)                         | Modified Ashworth Scale Bohannon & Smith (1987)  |
|-------|---|--|
| 0 (0) | No increase in tone                           | No increase in muscle tone   |
| 1 (1) | Slight increase in tone catch when limb moved | Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension. |
| 1+(2) |   | Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM (range of movement).                          |
| 2 (3) | marked increase in tone limb easily flexed    | More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved.  |
| 3 (4) | passive movement difficult                    | Considerable increase in muscle tone passive, movement difficult.  |
| 4 (5) | Limb rigid                                    | Affected part(s) rigid in flexion or extension.  |

## Appendix II

### GROSS MOTOR FUNCTION MEASURE (GMFM) SCORE SHEET (GMFM-88 and GMFM-66 scoring)

Child's Name: \_\_\_\_\_ ID#: \_\_\_\_\_

Assessment Date: \_\_\_\_\_ GMFCS Level<sup>1</sup>:  
year / month / day  I  II  III  IV  V

Date of Birth: \_\_\_\_\_  
year / month / day

Chronological Age: \_\_\_\_\_ Evaluator's Name: \_\_\_\_\_  
year / month / day

Testing Condition (e.g., room, clothing, time, others present): \_\_\_\_\_

The GMFM is a standardized observational instrument designed and validated to measure change in gross motor function over time in children with cerebral palsy. The scoring key is meant to be a general guideline. However, most of the items have specific descriptors for each score. It is imperative that the guidelines contained in the manual be used for scoring each item.

| SCORING KEY        |  |
|--------------------|--|
| 0                  | = does not initiate                              |
| 1                  | = initiates                                      |
| 2                  | = partially completes                            |
| 3                  | = completes                                      |
| 9 (or leave blank) | = not tested (NT) [used for the GMAE-2 scoring*] |

**It is important to differentiate a true score of "0" (child does not initiate) from an item which is Not Tested (NT) if you are interested in using the GMFM-66 Ability Estimator (GMAE) Software.**

The most accurate version of the GMFM-66 scoring program is the GMAE-3. It is included in the GMFM App+ which is available from the CanChild shop (<https://www.canchild.ca/en/shop>). The GMAE-2 is available at [www.canchild.ca](http://www.canchild.ca) but is incompatible with newer computer operating systems. The GMFM-66 is only valid for use with children who have cerebral palsy tested without shoes, orthoses, or aides.

#### Contact for Research Group:

CanChild Centre for Childhood Disability Research,  
Institute for Applied Health Sciences, McMaster University,  
1400 Main St. W., Room 408,  
Hamilton, ON Canada L8S 1C7  
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<sup>1</sup>GMFCS level is a rating of severity of motor function. Definitions for the GMFCS-E&R (expanded & revised) are found in Palisano et al. (2008). *Developmental Medicine & Child Neurology*. 50:744-750 and in the GMAE-3 scoring software. <http://motorgrowth.canchild.ca/en/GMFCS/resources/GMFCS-ER.pdf>



Check (3) the appropriate score: if an item is not tested (NT), circle the item number on the right column

| Item                     | A: LYING & ROLLING  | SCORE                      |                            |                            |                            | NT  |
|--------------------------|---|----------------------------|----------------------------|----------------------------|----------------------------|-----|
| 1.                       | SUP, HEAD IN MIDLINE: TURNS HEAD WITH EXTREMITIES SYMMETRICAL .....           | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 1.  |
| * 2.                     | SUP: BRINGS HANDS TO MIDLINE, FINGERS ONE WITH THE OTHER.....                 | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 2.  |
| 3.                       | SUP: LIFTS HEAD 45° .....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 3.  |
| 4.                       | SUP: FLEXES R HIP & KNEE THROUGH FULL RANGE .....                             | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 4.  |
| 5.                       | SUP: FLEXES L HIP & KNEE THROUGH FULL RANGE.....                              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 5.  |
| * 6.                     | SUP: REACHES OUT WITH R ARM, HAND CROSSES MIDLINE TOWARD TOY.....             | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 6.  |
| * 7.                     | SUP: REACHES OUT WITH L ARM, HAND CROSSES MIDLINE TOWARD TOY .....            | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 7.  |
| 8.                       | SUP: ROLLS TO PR OVER R SIDE .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 8.  |
| 9.                       | SUP: ROLLS TO PR OVER L SIDE .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 9.  |
| * 10.                    | PR: LIFTS HEAD UPRIGHT.....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 10. |
| 11.                      | PR ON FOREARMS: LIFTS HEAD UPRIGHT, ELBOWS EXT., CHEST RAISED.....            | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 11. |
| 12.                      | PR ON FOREARMS: WEIGHT ON R FOREARM, FULLY EXTENDS OPPOSITE ARM FORWARD.....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 12. |
| 13.                      | PR ON FOREARMS: WEIGHT ON L FOREARM, FULLY EXTENDS OPPOSITE ARM FORWARD ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 13. |
| 14.                      | PR: ROLLS TO SUP OVER R SIDE.....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 14. |
| 15.                      | PR: ROLLS TO SUP OVER L SIDE .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 15. |
| 16.                      | PR: PIVOTS TO R 90° USING EXTREMITIES .....                                   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 16. |
| 17.                      | PR: PIVOTS TO L 90° USING EXTREMITIES.....                                    | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 17. |
| <b>TOTAL DIMENSION A</b> |   |                            |                            |                            |                            |     |

| Item                     | B: SITTING   | SCORE                      |                            |                            |                            | NT  |
|--------------------------|--|----------------------------|----------------------------|----------------------------|----------------------------|-----|
| * 18.                    | SUP, HANDS GRASPED BY EXAMINER: PULLS SELF TO SITTING WITH HEAD CONTROL.....                         | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 18. |
| 19.                      | SUP: ROLLS TO R SIDE, ATTAINS SITTING .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 19. |
| 20.                      | SUP: ROLLS TO L SIDE, ATTAINS SITTING .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 20. |
| * 21.                    | SIT ON MAT, SUPPORTED AT THORAX BY THERAPIST: LIFTS HEAD UPRIGHT, MAINTAINS 3 SECONDS .....          | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 21. |
| * 22.                    | SIT ON MAT, SUPPORTED AT THORAX BY THERAPIST: LIFTS HEAD MIDLINE, MAINTAINS 10 SECONDS .....         | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 22. |
| * 23.                    | SIT ON MAT, ARM(S) PROPPING: MAINTAINS, 5 SECONDS .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 23. |
| * 24.                    | SIT ON MAT: MAINTAIN, ARMS FREE, 3 SECONDS .....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 24. |
| * 25.                    | SIT ON MAT WITH SMALL TOY IN FRONT: LEANS FORWARD, TOUCHES TOY, RE-ERECTS WITHOUT ARM PROPPING ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 25. |
| * 26.                    | SIT ON MAT: TOUCHES TOY PLACED 45° BEHIND CHILD'S R SIDE, RETURNS TO START .....                     | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 26. |
| * 27.                    | SIT ON MAT: TOUCHES TOY PLACED 45° BEHIND CHILD'S L SIDE, RETURNS TO START.....                      | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 27. |
| 28.                      | R SIDE SIT: MAINTAINS, ARMS FREE, 5 SECONDS .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 28. |
| 29.                      | L SIDE SIT: MAINTAINS, ARMS FREE, 5 SECONDS .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 29. |
| * 30.                    | SIT ON MAT: LOWERS TO PR WITH CONTROL .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 30. |
| * 31.                    | SIT ON MAT WITH FEET IN FRONT: ATTAINS 4 POINT OVER R SIDE.....                                      | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 31. |
| * 32.                    | SIT ON MAT WITH FEET IN FRONT: ATTAINS 4 POINT OVER L SIDE.....                                      | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 32. |
| 33.                      | SIT ON MAT: PIVOTS 90°, WITHOUT ARMS ASSISTING.....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 33. |
| * 34.                    | SIT ON BENCH: MAINTAINS, ARMS AND FEET FREE, 10 SECONDS.....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 34. |
| * 35.                    | STD: ATTAINS SIT ON SMALL BENCH .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 35. |
| * 36.                    | ON THE FLOOR: ATTAINS SIT ON SMALL BENCH .....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 36. |
| * 37.                    | ON THE FLOOR: ATTAINS SIT ON LARGE BENCH .....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 37. |
| <b>TOTAL DIMENSION B</b> |  |                            |                            |                            |                            |     |



| Item  | C: CRAWLING & KNEELING  | SCORE                      |                            |                            |                            | NT  |
|-------|---|----------------------------|----------------------------|----------------------------|----------------------------|-----|
| 38.   | PR: CREEPS FORWARD 1.8m (6') .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 38. |
| * 39. | 4 POINT: MAINTAINS, WEIGHT ON HANDS AND KNEES, 10 SECONDS .....                       | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 39. |
| * 40. | 4 POINT: ATTAINS SIT ARMS FREE .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 40. |
| * 41. | PR: ATTAINS 4 POINT, WEIGHT ON HANDS AND KNEES .....                                  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 41. |
| * 42. | 4 POINT: REACHES FORWARD WITH R ARM, HAND ABOVE SHOULDER LEVEL .....                  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 42. |
| * 43. | 4 POINT: REACHES FORWARD WITH L ARM, HAND ABOVE SHOULDER LEVEL .....                  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 43. |
| * 44. | 4 POINT: CRAWLS OR HITCHES FORWARD 1.8m(6') .....                                     | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 44. |
| * 45. | 4 POINT: CRAWLS RECIPROCALLY FORWARD 1.8m ( 6') .....                                 | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 45. |
| * 46. | 4 POINT: CRAWLS UP 4 STEPS ON HANDS AND KNEES/FEET .....                              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 46. |
| 47.   | 4 POINT: CRAWLS BACKWARDS DOWN 4 STEPS ON HANDS AND KNEES/FEET .....                  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 47. |
| * 48. | SIT ON MAT: ATTAINS HIGH KN USING ARMS, MAINTAINS, ARMS FREE, 10 SECONDS .....        | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 48. |
| 49.   | HIGH KN: ATTAINS HALF KN ON R KNEE USING ARMS, MAINTAINS, ARMS FREE, 10 SECONDS ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 49. |
| 50.   | HIGH KN: ATTAINS HALF KN ON L KNEE USING ARMS, MAINTAINS, ARMS FREE, 10 SECONDS ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 50. |
| * 51. | HIGH KN: KN WALKS FORWARD 10 STEPS, ARMS FREE .....                                   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 51. |

TOTAL DIMENSION C

| Item  | D: STANDING   | SCORE                      |                            |                            |                            | NT  |
|-------|---|----------------------------|----------------------------|----------------------------|----------------------------|-----|
| * 52. | ON THE FLOOR: PULLS TO STD AT LARGE BENCH .....                             | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 52. |
| * 53. | STD: MAINTAINS, ARMS FREE, 3 SECONDS .....                                  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 53. |
| * 54. | STD: HOLDING ON TO LARGE BENCH WITH ONE HAND, LIFTS R FOOT, 3 SECONDS ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 54. |
| * 55. | STD: HOLDING ON TO LARGE BENCH WITH ONE HAND, LIFTS L FOOT, 3 SECONDS ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 55. |
| * 56. | STD: MAINTAINS, ARMS FREE, 20 SECONDS .....                                 | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 56. |
| * 57. | STD: LIFTS L FOOT, ARMS FREE, 10 SECONDS .....                              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 57. |
| * 58. | STD: LIFTS R FOOT, ARMS FREE, 10 SECONDS .....                              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 58. |
| * 59. | SIT ON SMALL BENCH: ATTAINS STD WITHOUT USING ARMS .....                    | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 59. |
| * 60. | HIGH KN: ATTAINS STD THROUGH HALF KN ON R KNEE, WITHOUT USING ARMS .....    | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 60. |
| * 61. | HIGH KN: ATTAINS STD THROUGH HALF KN ON L KNEE, WITHOUT USING ARMS .....    | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 61. |
| * 62. | STD: LOWERS TO SIT ON FLOOR WITH CONTROL, ARMS FREE .....                   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 62. |
| * 63. | STD: ATTAINS SQUAT, ARMS FREE .....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 63. |
| * 64. | STD: PICKS UP OBJECT FROM FLOOR, ARMS FREE, RETURNS TO STAND .....          | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 64. |

TOTAL DIMENSION D

| Item  | E: WALKING, RUNNING & JUMPING  | SCORE                      |                            |                            |                            | NT  |
|-------|--|----------------------------|----------------------------|----------------------------|----------------------------|-----|
| * 65. | STD, 2 HANDS ON LARGE BENCH: CRUISES 5 STEPS TO R .....                              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 65. |
| * 66. | STD, 2 HANDS ON LARGE BENCH: CRUISES 5 STEPS TO L .....                              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 66. |
| * 67. | STD, 2 HANDS HELD: WALKS FORWARD 10 STEPS .....                                      | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 67. |
| * 68. | STD, 1 HAND HELD: WALKS FORWARD 10 STEPS .....                                       | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 68. |
| * 69. | STD: WALKS FORWARD 10 STEPS .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 69. |
| * 70. | STD: WALKS FORWARD 10 STEPS, STOPS, TURNS 180°, RETURNS .....                        | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 70. |
| * 71. | STD: WALKS BACKWARD 10 STEPS .....   | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 71. |
| * 72. | STD: WALKS FORWARD 10 STEPS, CARRYING A LARGE OBJECT WITH 2 HANDS .....              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 72. |
| * 73. | STD: WALKS FORWARD 10 CONSECUTIVE STEPS BETWEEN PARALLEL LINES 20cm (8") APART ..... | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 73. |
| * 74. | STD: WALKS FORWARD 10 CONSECUTIVE STEPS ON A STRAIGHT LINE 2cm (3/4") WIDE .....     | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 74. |
| * 75. | STD: STEPS OVER STICK AT KNEE LEVEL, R FOOT LEADING .....                            | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 75. |
| * 76. | STD: STEPS OVER STICK AT KNEE LEVEL, L FOOT LEADING .....                            | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 76. |
| * 77. | STD: RUNS 4.5m (15'), STOPS & RETURNS .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 77. |
| * 78. | STD: KICKS BALL WITH R FOOT .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 78. |
| * 79. | STD: KICKS BALL WITH L FOOT .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 79. |
| * 80. | STD: JUMPS 30cm (12") HIGH, BOTH FEET SIMULTANEOUSLY .....                           | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 80. |
| * 81. | STD: JUMPS FORWARD 30 cm (12"), BOTH FEET SIMULTANEOUSLY .....                       | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 81. |
| * 82. | STD ON R FOOT: HOPS ON R FOOT 10 TIMES WITHIN A 60cm (24") CIRCLE .....              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 82. |
| * 83. | STD ON L FOOT: HOPS ON L FOOT 10 TIMES WITHIN A 60cm (24") CIRCLE .....              | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 83. |
| * 84. | STD, HOLDING 1 RAIL: WALKS UP 4 STEPS, HOLDING 1 RAIL, ALTERNATING FEET .....        | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 84. |
| * 85. | STD, HOLDING 1 RAIL: WALKS DOWN 4 STEPS, HOLDING 1 RAIL, ALTERNATING FEET .....      | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 85. |
| * 86. | STD: WALKS UP 4 STEPS, ALTERNATING FEET .....  | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 86. |
| * 87. | STD: WALKS DOWN 4 STEPS, ALTERNATING FEET .....                                      | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 87. |
| * 88. | STD ON 15cm (6") STEP: JUMPS OFF, BOTH FEET SIMULTANEOUSLY .....                     | 0 <input type="checkbox"/> | 1 <input type="checkbox"/> | 2 <input type="checkbox"/> | 3 <input type="checkbox"/> | 88. |

TOTAL DIMENSION E

Was this assessment indicative of this child's "regular" performance? YES  NO

COMMENTS:

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## GMFM-88 SUMMARY SCORE

| DIMENSION                     | CALCULATION OF DIMENSION % SCORES |   |    |         | GOAL AREA                |                             |
|-------------------------------|-----------------------------------|---|----|---------|--------------------------|-----------------------------|
|                               |                                   |   |    |         | (indicated with ✓ check) |                             |
| A. Lying & Rolling            | Total Dimension A<br>51           | =   | 51 | × 100 = | _____ %                  | A. <input type="checkbox"/> |
| B. Sitting                    | Total Dimension B<br>60           | =   | 60 | × 100 = | _____ %                  | B. <input type="checkbox"/> |
| C. Crawling & Kneeling        | Total Dimension C<br>42           | =   | 42 | × 100 = | _____ %                  | C. <input type="checkbox"/> |
| D. Standing                   | Total Dimension D<br>39           | =   | 39 | × 100 = | _____ %                  | D. <input type="checkbox"/> |
| E. Walking, Running & Jumping | Total Dimension E<br>72           | =   | 72 | × 100 = | _____ %                  | E. <input type="checkbox"/> |
| <b>TOTAL SCORE =</b>          |                                   | $\frac{\%A + \%B + \%C + \%D + \%E}{\text{Total \# of Dimensions}}$                                   |    |         |                          |                             |
|                               | =                                 | _____   | =  | _____   | =                        | _____ %                     |
|                               |                                   | 5   |    |         |                          |                             |
| <b>GOAL TOTAL SCORE =</b>     |                                   | $\frac{\text{Sum of \%scores for each dimension identified as a goal area}}{\text{\# of Goal areas}}$ |    |         |                          |                             |
|                               | =                                 | _____   | =  | _____   | =                        | _____ %                     |

**GMFM-66 Gross Motor Ability Estimator Score <sup>1</sup>**

GMFM-66 Score = \_\_\_\_\_ to \_\_\_\_\_  
95% Confidence Intervals

previous GMFM-66 Score = \_\_\_\_\_ to \_\_\_\_\_  
95% Confidence Intervals

change in GMFM-66 = \_\_\_\_\_

<sup>1</sup> from the Gross Motor Ability Estimator (GMAE-3) Software

## TESTING WITH AIDS/ORTHOSES USING THE GMFM-88

Indicate below with a check (✓) which aid/orthosis was used and what dimension it was first applied. (There may be more than one).

| AID                    | Dimension                      | Orthosis                 | Dimension                      |
|------------------------|--------------------------------|--------------------------|--------------------------------|
| Rollator/pusher .....  | <input type="checkbox"/> _____ | Hip Control .....        | <input type="checkbox"/> _____ |
| Walker .....           | <input type="checkbox"/> _____ | Knee Control .....       | <input type="checkbox"/> _____ |
| H Frame crutches ..... | <input type="checkbox"/> _____ | Ankle-foot Control ..... | <input type="checkbox"/> _____ |
| Crutches .....         | <input type="checkbox"/> _____ | Foot Control .....       | <input type="checkbox"/> _____ |
| Quad Cane .....        | <input type="checkbox"/> _____ | Shoes .....              | <input type="checkbox"/> _____ |
| Cane .....             | <input type="checkbox"/> _____ | None .....               | <input type="checkbox"/> _____ |
| None .....             | <input type="checkbox"/> _____ | Other                    | <input type="checkbox"/> _____ |
| Other                  | <input type="checkbox"/> _____ | _____                    |                                |
| (please specify)       |                                | (please specify)         |                                |

## GMFM-88 SUMMARY SCORE USING AIDS/ORTHOSES

| DIMENSION                     | CALCULATION OF DIMENSION % SCORES   |   |                       | GOAL AREA                   |
|-------------------------------|---|---|-----------------------|-----------------------------|
|                               |   |   |                       | (indicated with ✓ check)    |
| A. Lying & Rolling            | Total Dimension A   | = | _____ × 100 = _____ % | A. <input type="checkbox"/> |
|                               | 51  |   | 51                    |                             |
| B. Sitting                    | Total Dimension B   | = | _____ × 100 = _____ % | B. <input type="checkbox"/> |
|                               | 60  |   | 60                    |                             |
| C. Crawling & Kneeling        | Total Dimension C   | = | _____ × 100 = _____ % | C. <input type="checkbox"/> |
|                               | 42  |   | 42                    |                             |
| D. Standing                   | Total Dimension D   | = | _____ × 100 = _____ % | D. <input type="checkbox"/> |
|                               | 39  |   | 39                    |                             |
| E. Walking, Running & Jumping | Total Dimension E   | = | _____ × 100 = _____ % | E. <input type="checkbox"/> |
|                               | 72  |   | 72                    |                             |
| <b>TOTAL SCORE =</b>          | $\frac{\%A + \%B + \%C + \%D + \%E}{\text{Total \# of Dimensions}}$                                   |   |                       |                             |
|                               | =   |   | _____ = _____ %       |                             |
|                               |   | 5 |                       |                             |
| <b>GOAL TOTAL SCORE =</b>     | $\frac{\text{Sum of \%scores for each dimension identified as a goal area}}{\text{\# of Goal areas}}$ |   |                       |                             |
|                               | =   |   | _____ = _____ %       |                             |

## Appendix III

### Pediatric Balance Scale (PBS)

A

#### PEDIATRIC BALANCE SCALE

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Location: \_\_\_\_\_ Examiner: \_\_\_\_\_

| <u>Item Description</u>                    | <u>Score</u><br>0 - 4 | <u>Seconds</u><br><i>optional</i> |
|--|-----------------------|-----------------------------------|
| 1. Sitting to standing                     | _____                 |                                   |
| 2. Standing to sitting                     | _____                 |                                   |
| 3. Transfers                               | _____                 |                                   |
| 4. Standing unsupported                    | _____                 | _____                             |
| 5. Sitting unsupported                     | _____                 | _____                             |
| 6. Standing with eyes closed               | _____                 | _____                             |
| 7. Standing with feet together             | _____                 | _____                             |
| 8. Standing with one foot in front         | _____                 | _____                             |
| 9. Standing on one foot                    | _____                 | _____                             |
| 10. Turning 360 degrees                    | _____                 | _____                             |
| 11. Turning to look behind                 | _____                 |                                   |
| 12. Retrieving object from floor           | _____                 |                                   |
| 13. Placing alternate foot on stool        | _____                 | _____                             |
| 14. Reaching forward with outstretched arm | _____                 |                                   |
| <b>Total Test Score</b>                    | _____                 |                                   |

#### General Instructions

1. Demonstrate each task and give instructions as written. A child may receive a practice trial on each item. If the child is unable to complete the task based on their ability to understand the directions, a second practice trial may be given. Verbal and visual directions may be clarified through the use of physical prompts.

2. Each item should be scored utilizing the 0 to 4 scale. Multiple trials are allowed on many of the items. The child's performance should be scored based upon the lowest criteria, which describes the child's best performance. If on the first trial a child receives the maximal score of 4, additional trials need not be administered. Several items require the child to maintain a given position for a specific time. Progressively, more points are deducted if the time or distance requirements are not met; if the subject's performance warrants supervision; or if the subject touches an external support or receives assistance from the examiner. Subjects should understand that they must maintain their balance while attempting the tasks. The choice, of which leg stand on or how far to reach, is left to the subject. Poor judgement will adversely influence the performance and the scoring. In addition to scoring items 4, 5, 6, 7, 8, 9, 10, and 13, the examiner may choose to record the exact time in seconds.

Figure. No caption available.



**B**

**Equipment**

The Pediatric Balance Scale was designed to require minimal use of specialized equipment. The following is a complete list of items required for administration of this tool:

- adjustable height bench
- chair with back support and arm rests
- stopwatch or watch with a second hand
- masking tape - 1 inch wide
- a step stool 6 inches in height
- chalkboard eraser
- ruler or yardstick
- a small level

The following items are optional and may be helpful during test administration:

- 2 child-size footprints
- blindfold
- a brightly colored object of at least two inches in size
- flash cards
- 2 inches of adhesive-backed hook Velcro
- Two 1 foot strips of loop Velcro

\*\*\*\*\*

**1. Sitting To Standing**

**\* *Special instruction:*** Items #1 and #2 may be tested simultaneously if, in the determination of the examiner, it will facilitate the best performance of the child.

**INSTRUCTIONS:** Child is asked to "Hold arms up and stand up." The child is allowed to select the position of his/her arms.

**EQUIPMENT:** A bench of appropriate height to allow the child's feet to rest supported on the floor with the hips and knees maintained in 90 degrees of flexion.

**Best Of Three Trials**

- ( ) 4 able to stand without using hands and stabilize independently
- ( ) 3 able to stand independently using hands
- ( ) 2 able to stand using hands after several tries
- ( ) 1 needs minimal assist to stand or to stabilize
- ( ) 0 needs moderate or maximal assist to stand

Figure. No caption available.

c

## 2. Standing To Sitting

\* **Special instruction:** Items #1 and #2 may be tested simultaneously if, in the determination of the examiner, it will facilitate the best performance of the child.

**INSTRUCTIONS:** Child is asked to sit down slowly, without use of hands. The child is allowed to select the position of his/her arms.

**EQUIPMENT:** A bench of appropriate height to allow the child's feet to rest supported on the floor with the hips and knees maintained in 90 degrees of flexion.

### Best Of Three Trials

- ( ) 4 sits safely with minimal use of hands
- ( ) 3 controls descent by using hands
- ( ) 2 uses back of legs against chair to control descent
- ( ) 1 sits independently, but has uncontrolled descent
- ( ) 0 needs assistance to sit

## 3. Transfers

**INSTRUCTIONS:** Arrange chair(s) for a stand pivot transfer, touching at a forty-five degree angle. **Ask the child to transfer one way toward a seat with armrests and one way toward a seat without armrests.**

**Equipment:** Two chairs, or one chair and one bench. One seating surface must have armrests. One chair/bench should be of standard adult size and the other should be of an appropriate height to allow the child to conformably sit with feet supported on the floor and ninety degrees of hip and knee flexion.

### Best Of Three Trials

- ( ) 4 able to transfer safely with minor use of hands
- ( ) 3 able to transfer safely; definite need of hands
- ( ) 2 able to transfer with verbal cueing and/or supervision (spotting)
- ( ) 1 needs one person to assist
- ( ) 0 needs two people to assist or supervise (close guard) to be safe

Figure. No caption available.

D

4. **Standing Unsupported**

**INSTRUCTIONS:** The child is asked to stand for 30 SECONDS without holding on or moving his/her feet. A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position. The child may be engaged in non-stressful conversation to maintain attention span for thirty seconds. Weight shifting and equilibrium responses in feet are acceptable; movement of the foot in space (off the support surface) indicates end of the timed trial.

**EQUIPMENT:** a stop watch or watch with a second hand  
a twelve inch long masking tape line or two footprints placed shoulder width apart

- ( ) 4 able to stand safely 30 SECONDS
- ( ) 3 able to stand 30 SECONDS with supervision (spotting)
- ( ) 2 able to stand 15 SECONDS unsupported
- ( ) 1 needs several tries to stand 10 SECONDS unsupported
- ( ) 0 unable to stand 10 SECONDS unassisted

\_\_\_\_\_ Time in seconds

*Special Instructions:* If a subject is able to stand 30 SECONDS unsupported, score full points for sitting unsupported. Proceed to item #6

5. **Sitting With Back Unsupported And Feet Supported On The Floor**

**INSTRUCTIONS:** Please sit with arms folded on your chest for 30 SECONDS. Child may be engaged in non-stressful conversation to maintain attention span for thirty seconds. Time should be stopped if protective reactions are observed in trunk or upper extremities.

**EQUIPMENT:** a stop watch or watch with a second hand  
a bench of appropriate height to allow the feet to rest supported on the floor with the hips and knees maintained in ninety degrees of flexion.

- ( ) 4 able to sit safely and securely 30 SECONDS
- ( ) 3 able to sit 30 SECONDS under supervision (spotting) or may require definite use of upper extremities to maintain sitting position
- ( ) 2 able to sit 15 SECONDS
- ( ) 1 able to sit 10 SECONDS
- ( ) 0 unable to sit 10 SECONDS without support

\_\_\_\_\_ Time in seconds

Figure. No caption available.



E

6. **Standing Unsupported With Eyes Closed**

**INSTRUCTIONS:** The child is asked to stand still with feet shoulder width apart and close his/her eyes for ten seconds. **Direction: "When I say close your eyes, I want you to stand still, close your eyes, and keep them closed until I say open."** If necessary, a blindfold may be used. Weight shifting and equilibrium responses in the feet are acceptable; movement of the foot in space (off the support surface) indicates end of timed trial. A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position.

**EQUIPMENT:** a stop watch or watch with a second hand  
a twelve-inch long masking tape line or two footprints placed  
shoulder width apart  
blindfold

Best Of 3 Trials.

- ( ) 4 able to stand 10 seconds safely
- ( ) 3 able to stand 10 seconds with supervision (spotting)
- ( ) 2 able to stand 3 seconds
- ( ) 1 unable to keep eyes closed 3 seconds but stays steady
- ( ) 0 needs help to keep from falling

\_\_\_\_\_ **Time in seconds**

7. **Standing Unsupported With Feet Together**

**INSTRUCTIONS:** The child is asked to place his/her feet together and stand still without holding on. The child may be engaged in non-stressful conversation to maintain attention span for thirty seconds. Weight shifting and equilibrium responses in feet are acceptable; movement of the foot in space (off the support surface) indicates end of timed trial. A taped line or footprints may be placed on the floor to help the child maintain stationary foot position.

**EQUIPMENT:** a stop watch or watch with a second hand  
a twelve inch long masking tape line or two footprints placed together

Best Of 3 Trials

- ( ) 4 able to place feet together independently and stand 30 seconds safely
- ( ) 3 able to place feet together independently and stand for 30 seconds with supervision (spotting)
- ( ) 2 able to place feet together independently but unable to hold for 30 seconds
- ( ) 1 needs help to attain position but able to stand 30 seconds with feet together
- ( ) 0 needs help to attain position and/or unable to hold for 30 seconds

\_\_\_\_\_ **Time in seconds**

Figure. No caption available.

F

### 8. Standing Unsupported One Foot In Front

**INSTRUCTIONS:** The child is asked to stand with one foot in front of the other, heel to toe. If the child cannot place feet in a tandem position (directly in front), they should be asked to step forward far enough to allow the heel of one foot to be placed ahead of the toes of the stationary foot. A taped line and/or footprints may be placed on the floor to help the child maintain a stationary foot position. In addition to a visual demonstration, a single physical prompt (assistance with placement) may be given. The child may be engaged in non-stressful conversation to maintain his/her attention span for 30 seconds. Weight shifting and/or equilibrium reactions in the feet are acceptable. Timed trials should be stopped if either foot moves in space (leaves the support surface) and/or upper extremities support is utilized.

**EQUIPMENT:** a stop watch or watch with a second hand  
a twelve inch long masking tape line or two footprints placed heel to toe

#### Best Of Three Trials

- ( ) 4 able to place feet tandem independently and hold 30 seconds
- ( ) 3 able to place foot ahead of other independently and hold 30 seconds.  
*Note:* The length of the step must exceed the length of the stationary foot and the width of the stance should approximate the subject's normal stride width.
- ( ) 2 able to take small step independently and hold 30 seconds, or required assistance to place foot in front, but can stand for 30 seconds.
- ( ) 1 needs help to step, but can hold 15 seconds
- ( ) 0 loses balance while stepping or standing

\_\_\_\_\_ Time in seconds

### 9. Standing On One Leg

**INSTRUCTIONS:** The child is asked to stand on one leg for as long as he/she is able to without holding on. If necessary the child can be instructed to maintain his/her arms (hands) on his/her hips (waist). A taped line or footprints may be placed on the floor to help the child maintain a stationary foot position. Weight shifting and/or equilibrium reactions in the feet are acceptable. Timed trials should be stopped if the weight-bearing foot moves in space (leaves the support surface), the up limb touches the opposite leg or the support surface and/or upper extremities are utilized for support.

**EQUIPMENT:** a stop watch or watch with a second hand  
a twelve inch long masking tape line or two footprints placed heel to toe

#### 3 Trials Average Score

- ( ) 4 able to lift leg independently and hold 10 seconds
- ( ) 3 able to lift leg independently and hold 5 to 9 seconds
- ( ) 2 able to lift leg independently and hold 3 to 4 seconds
- ( ) 1 tries to lift leg; unable to hold 3 seconds but remains standing
- ( ) 0 unable to try or needs assist to prevent fall

Figure. No caption available.

G

10. Turn 360 Degrees

**INSTRUCTIONS:** The child is asked to turn completely around in a full circle, STOP, and then turn a full circle in the other direction.

**EQUIPMENT:** A stop watch or watch with a second hand

- ( ) 4 able to turn 360 degrees safely in 4 seconds or less each way (total of less than eight seconds)
- ( ) 3 able to turn 360 degrees safely in one direction only in 4 seconds or less completes turn in other direction requires more than four seconds
- ( ) 2 able to turn 360 degrees safely but slowly
- ( ) 1 needs close supervision (spotting) or constant verbal cueing
- ( ) 0 needs assistance while turning

\_\_\_\_\_ Time in seconds

11. Turning To Look Behind Left & Right Shoulders While Standing Still

**INSTRUCTIONS:** The child is asked to stand with his/her feet still, fixed in one place. "Follow this object as I move it. Keep watching it as I move it, but don't move your feet."

**EQUIPMENT:** a brightly colored object of at least two inches in size, or flash cards  
a twelve inch long masking tape line or two footprints placed shoulder width apart

- ( ) 4 looks behind/over each shoulder; weight shifts include trunk rotation
- ( ) 3 looks behind/over one shoulder with trunk rotation; weight shift in the opposite direction is to the level of the shoulder; no trunk rotation
- ( ) 2 turns head to look to level of shoulder; no trunk rotation
- ( ) 1 needs supervision (spotting) when turning; the chin moves greater than half the distance to the shoulder
- ( ) 0 needs assist to keep from losing balance or falling; movement of the chin is less than half the distance to the shoulder

12. Pick Up Object From The Floor From A Standing Position

**INSTRUCTIONS:** The child is asked to pick up a chalkboard eraser placed approximately the length of his/her foot in front of his/her dominant foot. In children, where dominance is not clear, ask the child which hand they want to use and place the object in front of that foot.

**EQUIPMENT:** a chalkboard eraser  
a taped line or footprints

- ( ) 4 able to pick up an eraser safely and easily
- ( ) 3 able to pick up eraser but needs supervision (spotting)
- ( ) 2 unable to pick up eraser but reaches 1 to 2 nches from eraser and keeps balance independently
- ( ) 1 unable to pick up eraser; needs supervision (spotting) while attempting
- ( ) 0 unable to try, needs assist to keep from losing balance or falling

Figure. No caption available.

H

13. **Placing Alternate Foot On Step Stool While Standing Unsupported**

**INSTRUCTIONS:** The child is asked to place each foot alternately on the step stool and to continue until each foot has touched the step/stool four times.

**EQUIPMENT:** a step/stool of four inches in height  
a stop watch or watch with a second hand.

- ( ) 4 stands independently and safely and completes 8 steps in 20 seconds
- ( ) 3 able to stand independently and complete 8 steps >20 seconds
- ( ) 2 able to complete 4 steps without assistance, but requires close supervision (spotting)
- ( ) 1 able to complete 2 steps; needs minimal assistance
- ( ) 0 needs assistance to maintain balance or keep from falling, unable to try

\_\_\_\_\_ Time in seconds

14. **Reaching Forward With Outstretched Arm While Standing**

**General Instruction And Set Up:** A yardstick affixed to a wall via Velcro strips will be used as the measuring tool. A taped line and/or footprints are used to maintain a stationary foot position. The child will be asked to reach as far forward without falling, and without stepping over the line. The MCP joint of the child's fisted hand will be used as the anatomical reference point for measurements. Assistance may be given to initially position the child's arm at 90 degrees. Support may not be provided during the reaching process. If 90 degrees of shoulder flexion cannot be obtained, then this item should be omitted.

**INSTRUCTIONS:** The child is asked to lift his/her arm up like this. "Stretch out your fingers, make a fist, and reach forward as far as you can without moving your feet."

3 Trials Average Results

**EQUIPMENT:** a yardstick or ruler  
a taped line or footprints  
a level

- ( ) 4 can reach forward confidently >10 inches
- ( ) 3 can reach forward >5 inches, safely
- ( ) 2 can reach forward >2 inches, safely
- ( ) 1 reaches forward but needs supervision (spotting)
- ( ) 0 loses balance while trying, requires external support

\_\_\_\_\_ **Total Test Score**  
**Maximum Score = 56**

Figure. No caption available.

**Appendix V**  
**Demographic Data Sheet**

- **Name:**
- **Age:**
- **Gender:**
- **Diagnosis:**
- **Date of onset:**
- **Type of onset:**
- **Type of CP:**
- **Starting date of physical therapy:**
- **Main problems:**
- **E-mail address:**
- **Telephone number:**

**Appendix VI**  
**Outcome measures Sheet**

|                        |  |
|------------------------|--|
| <b>• Child name</b>    |  |
| <b>• Serial number</b> |  |

| <b>Outcome measures</b> | <b>Pre-Treatment<br/>Evaluation<br/>Date...../...../.....</b> | <b>Post-Treatment<br/>Evaluation<br/>Date...../...../.....</b> |
|-------------------------|---|--|
| <b>GMFM 88</b>          |   |  |
| <b>PBS</b>              |   |  |

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