

Functionality evaluation of children with spastic cerebral palsy

Avaliação da funcionalidade da criança com paralisia cerebral espástica

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ABSTRACT

Cerebral palsy is the result of a non-progressive lesion on the developing central nervous system and can lead to motor dysfunction, movement disorders, mental and functional changes. Spasticity is a motor and postural abnormality most commonly seen in cerebral palsy. Considering the multiple spasticity effects on the functionality of the individual with cerebral palsy, it becomes clear that a clinical evaluation must be precise and direct itself to the specific aspects that require intervention. This text is intended as a guide to the doctors or therapists in choosing the quantitative and qualitative measurements.

Keywords: Child, Cerebral Palsy, Muscle Spasticity, Scales

RESUMO

A paralisia cerebral é resultante de uma lesão não progressiva sobre o sistema nervoso central em desenvolvimento e que pode levar a disfunções motoras, distúrbios no movimento, deficiências mentais e alterações funcionais. A espasticidade é a anormalidade motora e postural mais comumente vista na paralisia cerebral. Considerando as múltiplas repercussões da espasticidade sobre a funcionalidade do indivíduo com paralisia cerebral, torna-se claro que uma avaliação do quadro clínico deve ser precisa e direcionar-se aos aspectos específicos que exigem intervenção. Este texto tem como objetivo servir de guia aos médicos ou terapeutas na escolha de instrumentos de medição quantitativa e qualitativa.

Palavras-chave: Criança, Paralisia Cerebral, Espasticidade Muscular, Escalas

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Conflict of Interest Statement

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INTRODUCTION

Numerous conditions can lead to an injury in the central nervous system (CNS) and cause upper motor neuron syndrome (UMNS). In UMNS, we observe two groups of signs and symptoms, the positives and the negatives ones. The negative signs refer to the absence of some features found in normal subjects and including fatigue, weakness and paralysis. The positive signs refer to the exacerbation of some features not found in normal subjects including spasticity, primitive reflexes, clonus and stiffness resulting from the lack of central inhibition.^{1,2}

The sum of positive and negative signs, acting on the musculoskeletal system, will lead to morphological changes that may culminate with disability deformities (Figure 1).

Spasticity is commonly defined as a motor disorder characterized by an increase in tonic stretch reflexes (muscle tone), dependent on speed, and facing tendon stimulation as part of the upper motor neuron syndrome. However, other spasticity clinical components may be present and include alteration of cutaneous and autonomic reflexes, loss of dexterity, motor paresis, fatigability and patterns of hyperactivity.³⁻⁵

Cerebral palsy is the result of a non-progressive lesion on the developing central nervous system and can lead to motor dysfunction, movement disorders, mental and functional changes.⁶

Spasticity is a motor and postural abnormality most commonly seen in cerebral palsy⁷⁻⁹ with an incidence between 75%¹⁰ to 88%.¹¹ In addition, spasticity can worsen other motor disorders present in Cerebral Palsy such as: a change in motor development, muscle weakness, impaired kinetics, impaired dexterity and movement control, abnormal posture, exaggerated reflexes, spasms, muscle shortening and joint deformities.¹²

However, not all clinical spasticity signs and symptoms of muscular hypertonia necessarily need to be treated or therapeutic intervention. Spasticity may possibly be beneficial. Its positive aspects include improvement in transfers, in orthostatics and eventually on gait, as a result of a tone increase in anti-gravitational muscles.⁴ Spasticity may allow removal of the paretic limb against potential harmful stimulus, helps prevent muscular atrophy and in controlling the loss of calcium from bones, reduces edema and the risk of developing deep vein thrombosis, besides helping in cardiovascular fitness.⁴

The negative spasticity aspects can interfere in rehabilitation and activities of daily life. Spasticity can produce pain, fractures and development positional sores.⁴ It may also interfere with bladder control, through the development of a urinary sphincter and detrusor muscle dyssynergia. Other aspects that may be aggravated by spasticity include: changes in posture, movement quality, painful spasms, abnormal gait, and difficulty with hygiene or other types of care. Moreover, spasticity may mask the true neurological deficit on voluntary muscle strength and mobility.⁴ The muscular imbalance generated by spasticity can lead to muscle shortening, and this to a torsional bone deformity, joint instability and disabling structured deformity.²

In the sequence of events, the upper motor neuron change produces muscle spasticity, but this does not affect all muscle groups equally and generates an imbalance of forces that along with the strength decrease, reduces the movement of the joint and limits the movement of the affected muscle (“primary disorder”- happens between 1-3 years old). Over time the tendons and muscles will shorten, bones continue to grow and irreducible contractures and osteoarticular deformities appear (“secondary disorder”- happens between 3-12 years old), taking the child to compensate for changes in posture and movement disorders (“tertiary disorder”).^{13,14}

It has been shown experimentally that the muscle tone increase interferes with the longitudinal growth of muscle contractures and converts the dynamic contractures into permanent ones. The spastic muscle grows less than the relaxed muscle.¹⁴

Genetically studying spastic mice a relative deficiency in growth of muscles and soft tissues compared to the bone growth rate was found, leading to contractures. Interestingly, it was noted that treatment with botulinum toxin can induce a normalization of muscle tone and consequently tendons growth. However, the tendon length remains changed for less if treatment is not performed during the different phases of growth.⁴

Despite the impossibility to relate this fact directly to children with cerebral palsy, the therapeutic window opened with the treatment creates an interesting series of conditions that may interfere with the course of the disease in these children.^{4,15}

Spasticity may be aggravated by pain, stress, fatigue, fever, colds, systemic diseases, sleeping disorders, constipation, diarrhea, tight clothes, poorly fitted orthoses, immobilization, and hormonal changes.¹² These

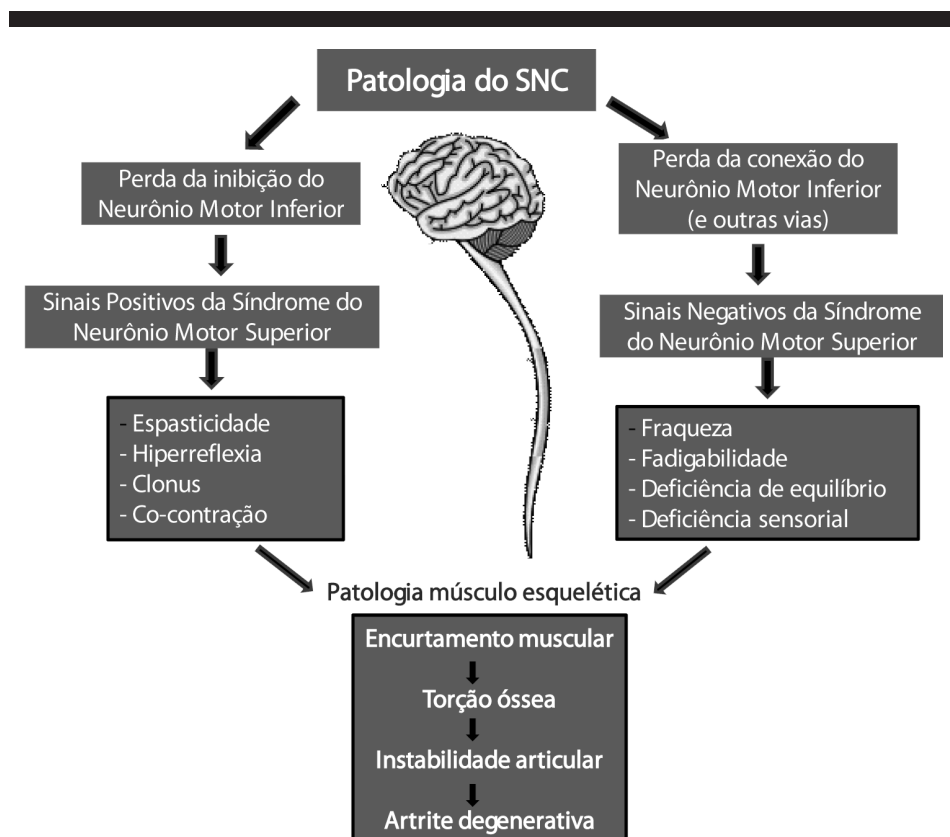


Figure 1 - Diagram showing the neuro-musculoskeletal pathology in cerebral palsy²

Chart 1 - Value of the rating scales proposed by the European Consensus on the treatment of spasticity in cerebral palsy

Scales	Recommended literature
Structure or body function	
Range of motion	Greene WB & Heckman JD 1994; ²² Allington NJ et al 2002; ²³ McDowell BC et al 2000; ²⁴ Fosang AL et al 2003 ²⁵
Modified Ashworth scale	Damiano DL et al 2002; ²⁶ Tilton AH 2006 ²⁷
Tardieu Scale	Boyd RN & Graham HK 1999; ²⁸ Morris S 2002; ²⁹ Calderón-González R & Calderón-Sepúlveda RF 2002; ³⁰ Haugh AB et al 2006 ³¹
3D Gait analysis (three dimensional)	Deslovere K et al 2001; ³² Zurcher AW et al 2001; ³³ Molenaers G et al 2006 ³⁴
Video documentation	Graham HK & Selber P 2003 ²
GAS (Goal Attainment Scale)	Maloney FP et al 1978; ³⁵ Maloney FP 1993; ³⁶ Palisano RJ 1993; ³⁷ Cusick A et al 2006 ³⁸
Activities and participation	
3D Gait analysis (three dimensional)	Deslovere K et al 2001; ³² Zurcher AW et al 2001; ³³ Molenaers G et al 2006 ³⁴
GMFM (Gross Motor Function Measure)	Palisano RJ et al 1997; ³⁹ Wood E & Rosenbaum P 2000; ⁴⁰ Palisano JR et al 2000 ⁴¹
MACS (Manual Ability Classification System)	Eliasson AC et al 2005 ⁴²
WeeFIM™ (Functional Independence Measure)	WeeFIM SystemSM 1998 ⁴³
PEDI (Paediatric Evaluation of Disability Inventory)	Feldman et al 1990 ⁴⁴
COPM (Canadian Occupational Performance Measure)	Cusick A et al 2006 ³⁸
QUEST (Quality of Upper Extremity Skills Test)	DeMatteo C et al 1992 ⁴⁵
BFMF (Bimanual Fine Motor Function)	Beckung E & Hagberg G 2002 ²⁰
AHA (Assisting Hand Assessment)	Eliasson AC et al 2005 ⁴²
Physician Rating Scale, Observational Gait Scale	Mackey AH et al 2003 ⁴⁶
Edinburgh Visual Gait Analysis Interval Testing Scale	Maathuis KG et al 2005; ⁴⁷ Read HS et al 2003 ⁴⁸
Energy Expenditure Measures	Rose J 1991; ⁴⁹ Ijzerman MJ & Nene AV 2002; ⁵⁰ Keefer DJ et al 2004 ⁵¹
GAS (Goal Attainment Scale)	Maloney FP et al 1978; ³⁵ Maloney FP 1993; ³⁶ Palisano RJ 1993; ³⁷ Cusick A et al 2006 ³⁸

aggravating factors must be corrected before the indication for spasticity treatment. It is also essential to do the balance between potential gains and adverse effects of spasticity treatment. We must also consider some cognitive factors: patient's emotional maturity of the and physical growth potential, presence or absence of positive and negative factors from the Upper Motor Neuron Syndrome, the distribution of spasticity and its cause, its chronic or acute aspects and psychosocial factors that influence adherence to treatment.¹²

Spasticity treatment is indicated when it interferes in any way in the functional aspects of comfort and care.¹⁶ The management of spasticity requires the combined efforts from a multidisciplinary rehabilitation team. The treatment goals should be carefully identified

and prioritized at each handling stage, with emphasis on early interventions that minimize and prevent disability.¹⁷

When spasticity is already established, treatment should improve the function (promoting the balance between agonist and antagonist muscles, improving transfers, mobility and daily life activities), relieve pain from muscle spasms during active and passive movements, facilitate care nursing and the use of orthoses to prevent secondary complications such as muscle contractures and bone deformities.^{1,5,8} These treatment goals will lead to an improvement in motion range and motor skill, bringing comfort to the patient besides improving quality of life and possibly facilitating other surgical interventions.^{6,18}

Considering the multiple spasticity effects on the functionality of the individual with ce-

Chart 2 - Modified Ashworth Scale¹⁴

Modified Ashworth scale

0 = no increase in muscle tone

1 = mild increase in muscle tone manifested by a "catch and release" or by minimal resistance at the motion range end when the affected limb is moved in flexion or extension.

1+ = mild increase in muscle tone manifested by a "catch followed by minimal resistance" through the remaining motion range (less than half the total motion range)

2 = more marked increase in muscle tone, manifested during most of the motion range, but the limb is moved easily.

3 = Considerable increase in muscle tone. The passive movement is difficult.

4 = affected part is rigid in flexion or extension

Chart 3 - Spasm Frequency Scale³⁰

Spasm Frequency Scale

0 = no spasms

1 = only spasms precipitated by stimuli

2 = spontaneous spasms, less than 1 spasm per hour

3 = spontaneous spasms, one or more spasms per hour

4 = spontaneous spasm, more than 10 spasms per hour

Chart 4 - Osteotendinous Reflexes Scale⁵²

Osteotendinous Reflexes Scale

0 = Absent

1 = Hyporeflexia

2 = Normal

3 = Mild Hyperreflexia

4 = Sustained Clonus (3 -4 repetitions)

5 = Unsustained Clonus

rebral palsy, it becomes clear that an clinical evaluation must be precise and direct itself to the specific aspects that require intervention. This text is intended as a guide to the doctors or therapists in choosing the quantitative and qualitative measurements.

Chart 5 - Muscular Strength Scale Modified³⁰

Muscular Strength Scale from the Medical Research Council

0 (absent) = total paralysis

1 (minimum) = visible muscular contraction without movement

2 (low) = movement without gravity action

3 (regular) = partial movement against gravity only

3+ (regular +) = full movement against gravity only

4- (good -) = full movement against gravity only and minimal resistance

4 (good) = full movement against gravity only and moderate resistance

4+ (Good +) = only complete movement against gravity and strong resistance

5 (normal) = complete movement against full resistance

Chart 6 - Hip Abductor Tonus Scale³⁹

Hip Abductor Tonus Scale

0 = no increase in muscle tone

1 = increased tone, easy hip abduction at 90 ° by a person

2 = hip abduction at 90 ° by a person with mild effort

3 = hip abduction at 90 ° by a person with moderate effort

4 = two people are required to achieve the abduction of the hips at 90 °

Chart 7 - Palisano's Motor Function Scale³⁹

Palisano's Motor Function Scale

I = walks without restrictions, limited advanced motor skills.

II = walks without walking aids, limitations on walking outdoors and in the community.

III = walks with help of walking aids, limitations on walking outdoors and in the community.

IV = moves with limitation; is transported or uses power equipment outdoors and in the community.

V = moves with great limitation even employing technological assistance

Tools for assessing the functionality in patients with spasticity

Functional evaluation of patients with spasticity should be individualized and carried out by a multidisciplinary team in order to document the maximum functional activity and thus facilitate the determination of treatment goals.⁵

Many scales have been developed to measure spasticity, although not all are susceptible to or reflect functional gains. According to the 2006 European Consensus for Treatment in Cerebral Palsy.¹⁹ Validated methods following concepts of the International Classification of Functioning, Disability and Health (ICF) from the World Health Organisation (WHO) should be used for evaluation and documentation (ICF on PC).^{20,21}

Chart 8 - Video Analysis Scale by Observation of the Gait^{15,28,30}

Observed variable	Description	Score by side	
1- position of the knee at intermediate support	Flexed		
	Severe > 15°	0	
	Moderate > 10° -15°	1	
	Discreet <10°	2	
	Neutral	3	
	Recurvatum		
	Discreet < 5°	2	
	Moderate > 5° -10°	1	
	Severe > 10°	0	
	2 - Initial foot contact	Toe tips	0
Plant of the forefoot		1	
Flat foot		2	
Calcaneus		3	
3 - Foot contact on the intermediate support		Toe tips – equine	-1
	Flat foot / heel raises soon	0	
	Flat foot / heel doesn't raises soon	1	
	Occasional heel/ occasional flat foot	2	
	Heel / toes (normal)	3	
	4- Heel raise movement	No contact of the heel - fixed equine	0
		Before 25% of the intermediate support (very early)	1
Between 25% and 50% - early		2	
At the end of the intermediate support		3	
Without lifting heel		0	
5 - Retro foot in an intermediate position	Varo	0	
	Valgus	1	
	Neutral	2	
6 - Base Support	Scissor	0	
	Narrow base	1	
	Broad base	2	
	Normal base (corresponding to the width of the shoulders)	3	
7- Gait Facilitator	Walker with assistance	0	
	Walker unassisted	1	
	Crutches and canes	2	
	None (Independent 10m)	3	
8- Change	Worse	-1	
	No	1	
	Better	2	

In this consensus¹⁹ the ratings are divided into two groups: assessment of body structure and function, and evaluation of activities and participation as shown on Chart 1.

Some scales are systematically used and recognized as useful in the quantification and qualification of spasticity and the comparative evaluation of treatment outcomes. Among them we can mention: spasms frequency scale, osteotendinous reflexes scale, muscular strength scale, tonus of the hip adductor scale, Palisano motor function scale, video analysis scale for gait observation, global assessment after treatment scale, FIM - functional independence measure (adults), Barthel index, gait quantification, gait velocity, timed up and go modified and GMFCS.

Modified Ashworth Scale

The modified Ashworth Scale is a subjective scale that assesses the tone in grades 0-4. It has proven reliable and is the scale most often cited in the spasticity treatment literature in both adults and children. Its features and graduation can be seen in Chart 2.

Tardieu Scale

This scale takes into account the stretch velocity parameters (V), muscle reaction quality (X) and muscle reaction angle (Y). For each muscle group, the response is measured at a particular speed in the two tested parameters X and Y.^{29,31}

Stretch velocity:

V1: as slow as possible

V2: speed of the limb fall under the action of gravity

V3: as fast as possible (faster than the speed of limb fall when under the action of gravity)

Note: V1 is used to measure passive range of motion; V2 and V3 are used for the spasticity measurement.

Muscle reaction quality X:

0 = no resistance through the course of passive movement

1 = little resistance through the course of passive movement, without a clear "catch" at a precise angle.

2 = Clear "catch" at an angle interrupting the passive movement, followed by relaxation.

3 = Sustained clonus (<10 seconds when maintained pressure) occurring at a precise angle.

4 = Unsustained clonus (> 10 seconds when maintained pressure) occurring at a precise angle.

Muscle Reaction Angle Y: measured on the position of lower muscle stretch (corresponding to an angle) for all joints except the hip, where is related to the anatomical position in rest.

Chart 9 - Physician Rating Scale – lower limbs⁵⁴

Physician Rating Scale				
Gait Pattern	Toes / toes	Occasionally heel / toes	Heel / toes	
	0	1	2	
Position of rear-foot (ankle in contact with the ground)	Equine	Calcaneus	Neutral	
	0	1	2	
Position of rear-foot (swing phase)	Valgus	Varo	Occasional neutral	Neutral
	0	1	2	3
Knee position (recurvatum degree)	Severe	Moderate	Light	Neutral / Flexed
	0	1	2	3
Squat during gait	Severe	Moderate	Light	None
	0	1	2	3
Gait Speed	Slow	Variable		
	0	1		

Upper limb: test in a sitting position, elbow flexed 90 ° (except when being tested), the joint positions and speeds recommended:

Shoulder: Horizontal Adductors (V3)

Elbow: Flexors (adducted shoulder, V2)
Vertical Adductors (V3)

Extensors (abducted shoulder, V3)

Internal rotators (V3)

Pronators (adducted shoulder, V3)

Supinators (adducted shoulder, V3)

assessing the tone of this region. In addition, subjectively evaluates the degree of effort required to complete the move by a second person other than the patient.

Palisano's Motor Function Scale

This is a simplification of the Gross Motor Function Classification System (GMFCS), distributed on five levels, according to the degree of independence in locomotion, with or without technological assistance, in open and closed environment.

Video Analysis Scale by Observation of the Gait

This is a scale where the gait is observed and scored by analyzing a video. The gait phases are evaluated and depending on the changes found, change of joint angles, the score is given. The total perfect score for an extremity is 25 points.

Physician Rating Scale (PRS) – the lower and upper limbs

Lower limbs

This scale measures six functional elements of the gait, which can be measured during the patient's walking with bare feet, for at least 15 steps. The total score ranges from 0-14, 14 being the best score possible.⁵³ It measures the following functional parameters:

1- gait pattern (0-2)

2- position of the ankle during gait (0-2)

3- foot elevation and curvature during gait (0-3)

4- position of the knee during gait (0-3)

5- degree of flexion and shortening of the lower limbs (0-3)

6- speed of gait (0-1).

Spasm Frequency Scale

This is a subjective scale, graded 0-4, where are observed the spontaneous spasms or those precipitated by stimuli in relation to frequency per hour.

Osteotendinous Reflexes Scale

This is a scale ranging from 0-5, which analyzes the intensity of the reflex response and the presence of clonus. We must remember that the hyporeflexia means a decrease in reflex response and, when possible, we must compare the individual's responses with himself, in an unaffected region. Hyperreflexia besides meaning an increased reflex response, it also means an increase in the reflexive area. Features of the osteotendinous reflexes scale can be seen in Chart 4.

Modified Muscular Strength Scale

The modified muscle strength scale is an observational measure based on the presence or absence of muscle contraction, with or without the action of gravity and with or without the imposition of an external resistance to movement.

Hip Abductor Tonus Scale

This is a 0-4 graduated scale, which has the hip abduction at 90° as the reference point for

Upper limbs

A similar scale was made for the upper limbs, where the movements are observed in standardized positions, evaluating the joint angles

and the influence of associated spasticity and bi-manual function. The top score reaches 47 points and may change due to the functional changes for better or for worse.

Chart 10 - Physician Rating Scale – upper limbs¹⁵

Parameters	Definition	Points
Active extension of the elbow (normal 180 °)	> 10° reducible	0
	0-10° reducible	1
	Not reducible	2
Active supination in extension (elbow extended, forearm supinated), Middle Position: palm 90 degrees to the horizontal	None	0
	Below the middle position	1
	Middle position	2
	Over the middle position	3
Active supination in flexion (elbow flexed 90 °, forearm supinated)	None	0
	Below the middle position	1
	Middle position	2
	Over the middle position	3
Active dorsi-flexion of the wrist (supported forearm). Middle Position: palm leveled with the forearm.	None	0
	Below the middle position	1
	Middle position	2
	Over the middle position	3
Dorsi-flexion of the wrist (angle of movement)	With ulnar deviation	0
	With radial deviation	0
	Neutral	1
Opening of the fingers	Only with wrist flexion	0
	With wrist in neutral position	1
	With the wrist in dorsi-flexion	2
Thumb Function	Palmed	0
	Pressed laterally to the index finger	1
	Aid partially on hold	2
	Possible pulp-pulp clamp	3
	Active abduction	4
	Increased muscle tone associated	0
Increased muscle tone associated	In all manipulative functions	0
	Only in the fine motor function	1
	Only walking or running	2
	None	3
Bimanual Function	None	0
	Poor	1
	Use for all functions, but limited in activities of daily living	2
	Use for all functions, without limiting the activities of daily living	3
	Total score	47
Change	Worse	-1
	None	0
	Small improvement	1
	Visible clinical improvement	2

Goal Attainment Scale (GAS)

This is a scale based on therapeutic goals achievement. The levels of achievement can vary from -2 to + 2 as Chart 11 below shows.

Although subjective, this scale is useful always and when the goals are adequately informed prior to treatment to patients and their families. The GAS is an instrument sensitive to interventional changes and a valid method for measuring clinically important changes in individuals. Nine steps are described as a guide and as a training aid for the implementation of GAS.⁵⁵

Step 1 = Identify the issues that will be the focus of treatment.

Step 2 = Convert selected problems in at least three goals.

Step 3 = Choose a short title for each goal.

Step 4 = Select an indicator for each goal.

Step 5 = Specify the degree of expected results for each goal.

Step 6 = Review of degrees of expected results.

Step 7 = Specify what is a little more and that is a little less to the degree expected from the results of a goal.

Chart 11 - Goal Attainment Scale (GAS)⁵⁵

Points	Level of achievement of results
-2	Much less than expected
-1	Slightly less than expected
0	Expected degree of results
+1	A little more than expected
+2	Much more than expected

Chart 12 - Global Assessment Scale after treatment^{14,56}

Points	Level of achievement of results
-2	Marked worsening of the tone and function
-1	Worsening
0	No changes
1	Slight improvement
2	Mild improvement, no functional change
3	Moderate improvement in tone and function
4	Marked improvement in tone and function

Step 8 = Specify what is much more and what is a lot less to the degree expected from the results of a goal.

Step 9 = Repeat these steps for each three or more goals.

Example of application of GAS³⁷

Child age: 6 months (adjusted age)

Diagnosis: delayed motor development

Equivalent score on the motor age: 2 months

Behavioral objective: when supported by the pelvis, the child will sit and use both hands to play with a toy for 60 seconds.

GAS: when supported by the pelvis the child: -2 = sits without bending the trunk for 10 seconds (initial level of goal)

-1 = sits without using hands for support for 30 seconds

0 = sits and uses his/ her hands to play with a toy for 60 seconds (reference)

+1 = sits with the trunk upright and uses his hands to play with a toy for 60 seconds

+2 = sits upright and rotates the trunk to both sides to reach the toy.

Global assessment after treatment

This is a scale with scores ranging from -2 to 4, where zero means no change, neither for better nor for worse. The global assessment after treatment scale assesses changes in tone and function in a subjective manner.

Functional Independence Measure (FIM)

It is an ordinal scale of activities that encompasses multiple areas: self care, sphincter control, mobility /transfers, locomotion, communication and social cognition. It is the most widely used assessment in rehabilitation and applies to a wide range of disabling conditions. The FIM includes 18 items, each scored from 7 (complete independence for the activity) until 1 (complete dependence) Consequently, the total sum can range from 18 to 126. The motor FIM encompasses the four primary functional areas (self care, sphincter control, mobility / transfer, locomotion) with 13 items and adding 13 to 91 and is directly related to spasticity.⁵⁷⁻⁵⁹

The analyzed levels of independence can be seen in Chart 13a and the evaluation items in Chart 13b. This scale is already translated and validated for the Portuguese in Brazil.⁶⁰⁻⁶²

At first, the FIM is a scale developed for adults, over 18 years. Its pediatric version is WeeFim, which is little used in Brazil and has no validity in Brazilian Portuguese so far.

Barthel Index

It is an ordinal scale of activities of daily living with 10 areas covering mobility, activities of

Chart 13a - Functional Independence Measure (FIM) - Functional areas and items to be evaluated

Date	Admission	Discharge	Following
Self care			
A. Feeding			
B. Personal Hygiene			
C. Bath (body wash)			
D. Dressing upper body half			
E. Dressing lower body half			
F. Use of toilet			
Sphincter control			
G. Urine control			
H. Fecal control			
Mobility / Transfers			
I. Bed, chair, wheelchair			
J. Toilet			
K. Bath, shower			
Locomotion			
L. Walk / Wheelchair			
M. Stairs			
Communication			
N. Comprehension			
O. Expression			
Social cognition			
P. Social interaction			
Q. Problems solving			
R. Memory			
Total			

daily living and continence.^{63,64} Each activity is described in Chart 14.

Quantification of functional mobility:

Velocity: is measured by the time required to traverse the distance of 25 steps with or without assistance.

Timed get up and go: the task consists of: from the sitting position, the patient should get up, lean on a limb and kick, as strong as possible a ball with the other limb. Then to walk in a straight line, counting backwards from 15 to 0, cycle one cone and get back toward a chair stepping into the center of circles marked on the floor. Reaching the chair, must stop and sit Figure 2. The score for the test varies from 0-18 according to Chart 15.

GMFM (Gross Motor Function Measure)

The GMFM is a measure established for evaluating changes in gross motor function in children with cerebral palsy. It consists of 88

Chart 13b - Functional Independence Measure (FIM) - Levels of independence

Levels	Levels
	Independence- Without help
7	Independently (and safely in normal time)
6	Modified independence (technical assistance)
	Modified dependence - Help
5	Supervision, guidance or preparation
4	Minimal assistance (individual makes more than 75% of the tasks alone)
3	Moderate help (individual makes 50% to 74% of the tasks alone)
2	Maximum help (individual makes 25% to 49% of the tasks alone)
1	Total aid (individual does not perform tasks alone)

items grouped into five dimensions: 1) lying and rolling (17 items), 2) sitting (20 items), 3) crawling and kneeling (14 items), 4) stand up (13 items), and 5) walking, running and jumping (24 items). The GMFM takes approximately 45 minutes to be done. All items can be generally completed at 5 years of age in children without motor function delay. The score is measured by observing the motor performance of children in each item. Items receive scores from 0 to 4 points on an ordinal scale. The scores for each dimension are expressed as percentages of the maximum score for that dimension. The total score is obtained through the sum of all dimensions divided by five, i.e. *the total number of dimensions*. Each dimension contributes equally to the total score ranging from 0 -

100. The reliability, validity and sensitivity of this instrument are documented for children with cerebral palsy and are considered acceptable.^{41,66}

GMFCS (Gross Motor Function Classification System)

Uses locomotion as key in assessing and analyzing the child in five levels of performance. The classification can be made after the child completes two years old, then new classifications should be made with intervals of two years to measure gains in skills until reaching a plateau between 6-18 years.⁴¹ The Chart 16 shows the different levels of the GMFCS.⁶⁷ This classification system expanded and revised according to the ages: before 2 years, between 2-4 years, between 4-6 years, between 6-12 years and between 12-18 years can be found at Palisano R et al.⁶⁸

There is a relation between the GMFCS levels I to III with the IFC (international function classification) in the components of body functions, structures, activities and participation. There is also a positive correlation of unilateral lesion with GMFCS level I and of the bilateral lesion and levels III, IV and V.^{13,69}

PEDI (Pediatric Evaluation of Disability Inventory)

The PEDI is a tool that uses information provided by parents or relatives of the child, in the form of a structured interview, used by pediatric clinicians and other rehabilitation professionals, to assess functional abilities in children. The items on the PEDI are grouped into three areas: self-care, mobility and social function. For each domain three scores are calculated independently: 1) level of func-

Chart 14 - Barthel Index

Variável Observada	Descrição	Pontuação
1- Eating	Independent. Is able to feed himself/herself after being served since be able to reach the food. Cuts food and seasons them alone, all within a reasonable time.	2
	Need some help to cut food	1
2- Transfers from wheelchair to bed and vice versa	Independent in all phases of this activity safely and without supervision	3
	Needs help during at least some phase of this activity. Needs to be warned about the safety factors in some phases of this activity.	2
	Patient can sit without help from a second person, but needs help getting out of bed, or a great help to transfer (a strong person, or two normal helpers)	1
3- Personal hygiene	Can wash hands and face, brush teeth, shave and comb his hair.	1
		0
4- Sitting and lifting from the toilet	Patient is able to sit down and raise from the toilet without compromising the clothing and to use toilet paper without help.	2
	Patient need help using the toilet, with clothes or toilet paper.	1
5- Taking Bath	Patient can bathe in a bath or shower using a sponge bath.	1
6- Walking in plain floor	Walk 45 meters without supervision on plan floor with the aid of apparatuses (walker with wheels excluded). Lock and unlock and orthopedic appliances and sit up without assistance	3
	Needs help or supervision for the task described above	2
6A-Wheelchair propulsion	Does not walk but uses the wheelchair properly and independently by at least 45 meters.	1
7- Going up and down the stairs	Patient is able to climb and descend stairs without help or supervision using support if necessary (handrails, canes)	2
	Needs help or supervision for the task described above	1
	Patient is unable to climb and descend stairs, needs constant supervision.	0
8-Dressing and Undressing	Patient can remove, quickly, clothes and appliances of every kind and wherever necessary.	2
	Needs help or supervision for the task described above	1
9- Bowel Control	Patient is able to control the bowel without accidents, can use suppository or enema if necessary. No need for supervision to defecate properly.	2
	Patient needs help to use a suppository or enema and has occasional accidents (1X/ week).	1
	Incontinent or frequently defecate in inappropriate places.	0
10-Bladder control	Patient is able to control bladder day and night. Patients who use collection bag or probes should manage them independently.	2
	Patients who have occasional accidents, can not reach the toilet in time or can not handle alone collectors, catheters or diapers.	1
	Incontinent that frequently urine in inappropriate places	0

tional ability, 2) help from a caregiver, and 3) modifications. The total scores are also calculated for each scale in each domain. The PEDI can be used on children between 6 months and 7 years old. Higher scores for the level of functional skills and caregiver assistance show a better performance and independence. Higher modification scores denote that more adjustments are necessary to carry out activities.⁷⁰

MACS – Manual Classification System

The purpose of the Manual Classification System (MACS) is to provide a systematic method to classify children with cerebral palsy in relation to how they use their hands when handling objects in daily activities. MACS is based on the manual skills that are initiated voluntarily, with particular emphasis on objects manipulation in the individual space of the patient (immediate area around the body at an unreachable distance from objects).⁷¹ There is no correlation between the GMFCS and MACS.⁷²

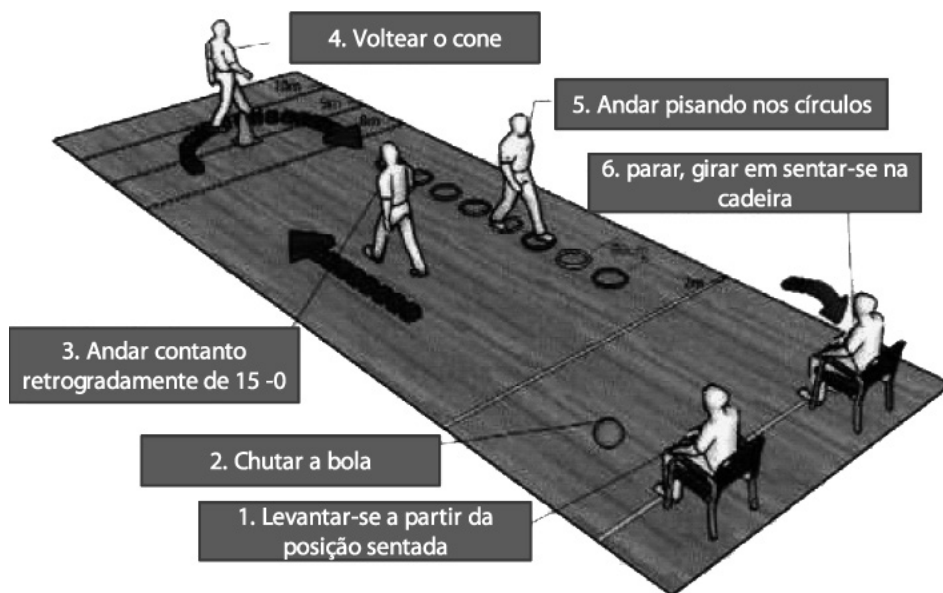


Figure 2 - Schematic drawing from the actions during a modified Timed get up and go test

Chart 15 - Points to a modified *Timed get up and go* test⁶⁵

Observed Variable	Description	Points
1- Standing up from sitting position	Can stand up without using the hands in a firm action and controlled action	3
	Can stand up using the hands in a firm action and controlled action	2
	Can stand up using the hands after multiple tries.	1
	Needs or requests help.	0
2- Kicking the ball	Kicks the ball without losing balance	3
	Kicks the ball, but steps back to regain balance.	2
	Kicks the ball having difficulty to find balance.	1
	Needs or requests help.	0
3- Walking in a straight line, counting backwards from 15 to 0.	Able to coordinate walking and counting without making mistakes.	3
	Able to coordinate walking and counting making one mistake.	2
	Poor coordination between walking and counting making several mistakes.	1
	Needs help or is unable to count.	0
4-Cycling the cone	Can cycle around the cone without touching it, without leaving the area demarcated and without losing rhythm.	3
	Can cycle around the cone without touching it, without leaving the area demarcated but diminishes gait rhythm	2
	Cycles around the cone with visible insecurity.	1
	Needs or requests help.	0
5-Stepping on the circles	Can walk stepping each foot in the center of the circles without touching the edges and without losing balance.	3
	Can walk stepping each foot in the center of the circles but touches in one of the borders or needs an extra step, outside the circle, to regain balance.	2
	Can walk stepping each foot in the center of the circles but touches many borders or needs extra steps, outside the circle, to regain balance.	1
	Needs or requests help.	0
6- Sitting again	Able to sit slowly without using the hands.	3
	Sits abruptly (thrown in the chair), hands-free	2
	Sits using hand support.	1
	Needs or requests help.	0

Chart 16 - Gross Motor Function Classification System

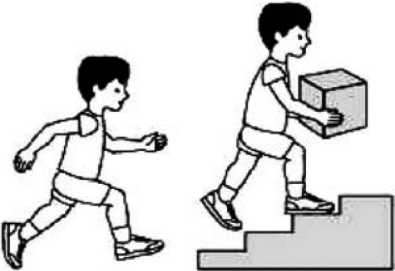
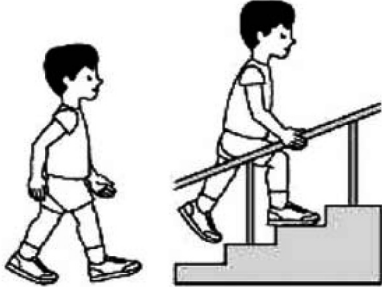
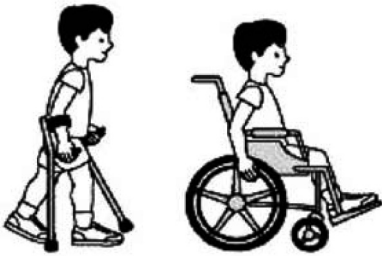
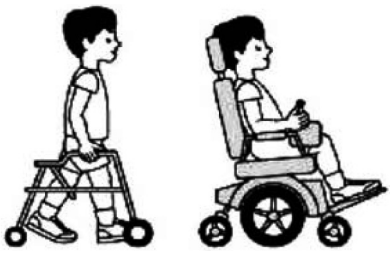

	<p>Level I Independent gait without limitations (at home an outside) Jump and run Difficulties in having velocity, coordination and balance</p>
	<p>Level II Walks at home and outside with limitations event on plane surfaces. Crawling in home Difficulty to jump and run</p>
	<p>Level III Walks at home and outside with crutches and walkers. Climb stairs holding onto railing. Depends on upper limb function to use the wheelchair for long distances.</p>
	<p>Level IV Sits in adapted chairs Transfers with an adult help. Walks with the help of a walker in short distances with difficulty on irregular surfaces. Can acquire autonomy in motorized wheelchair</p>
	<p>Level V Needs adaptations to sit Totally dependent for daily life activities and locomotion. Can use motorized wheelchair with adaptations</p>

Chart 17 - MACS Level

Level	Capabilities
I	Handles objects easily and successfully There may be restrictions on speed and dexterity tasks Without limiting the activities of daily living
II	Handles most objects, but slowly. Can choose alternative ways of execution Without limiting the activities of daily living
III	Handles objects with difficulty Needs help to prepare or modify the activities The execution is slow and the successful results are limited in quantity and quality May require adjustments
IV	Handles only a few specially selected objects Takes effort and has limited success Requires ongoing support and assistance and / or adjustments to achieve partial successes
V	Does not manipulate objects Has limited ability to perform simple actions of manipulation Requires total assistance for very simple tasks

CONCLUSION

The instruments for assessment and functional documentation currently in use for individuals with cerebral palsy are extensive and cover several different aspects of the patient's functionality according to the model proposed by the CIF. The choice and use depend on the therapeutic objectives and targets to be achieved; for this, the knowledge of the instruments described above favors the framework for therapeutic strategies design.

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