

## Suggested Arabic Rehabilitation Guidelines for Cerebral Palsy: An Overview

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### Abstract

This paper accurately interprets the concept, definition, and meaning of the nouns in the definition of cerebral palsy, as well as introduces the methods of its assessments, standardizes the diagnosis and classification, scientifically summarizes and introduces the international research hot spots of the early prediction of cerebral palsy, the diagnosis of high risk of cerebral palsy and its differential diagnosis. It is important guiding significance for clinicians and professionals to comprehensively understand, accurately diagnose, and early predict cerebral palsy.

### Keywords:

Cerebral palsy, Definition, Evaluation, Diagnosis, Classification, Prediction of cerebral palsy, Infants at high risk of cerebral palsy

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## المبادئ الإرشادية العربية المقترحة لإعادة التأهيل للشلل الدماغي: نظرة عامة

### المستخلص

تفسر هذه الورقة بدقة مفهوم وتعريف والمعاني في تعريف الشلل الدماغي، كما تقدم طرق تقييمه، وتوحيد التشخيص والتصنيف، وتلخص بشكل علمي وتقدم النقاط البحثية الدولية الساخنة للتنبؤ المبكر بالشلل الدماغي، وتشخيص ارتفاع خطر الإصابة بالشلل الدماغي وتشخيصه التفريقي. هذه المبادئ الإرشادية مهمة للأطباء والمهنيين لفهم الشلل الدماغي بشكل شامل وتشخيصه بدقة والتنبؤ به مبكرًا.

### الكلمات المفتاحية:

الشلل الدماغي، التعريف، التقييم، التشخيص، التصنيف، التنبؤ بالشلل الدماغي، الاطفال الأكثر عرضة للإصابة بالشلل الدماغي

## 1. Definition of cerebral palsy

### 1.1. Definition

Cerebral palsy (CP) is a group of persistent central motor and postural developmental disorders and activity limitation syndromes caused by non-progressive brain damage in developing fetuses or infants. The movement disorders of cerebral palsy are often accompanied by sensory, perception, cognition, communication, and behavioral disorders, as well as epilepsy and secondary muscle and bone problems (Patel et al., 2020).

CP is a developmental disorder that affects a child's lifelong developmental trajectory and family life. Therefore, interventions must be considered from the perspective of promoting functional development and supporting family rehabilitation services (Dar et al., 2024).

### 2. Explanation of terms

Focus on the following explanations (Francés et al., 2022)

#### 1.2.1. A group

The emphasis is on syndromes of different types and severity caused by different causes.

#### 1.2.2. Permanent

Transient abnormalities are excluded, but it is important to note that the pattern of clinical abnormalities is constantly changing.

#### 1.2.3. Activity limitation

Activity refers to the individual performing a task or action; activity limitation refers to the individual's difficulty in activities.

#### **1.2.4. Movement and posture**

Refers to abnormal movement patterns and postures, ataxia, and abnormal muscle tone. Abnormal motor control is the core manifestation of cerebral palsy. Other neurodevelopmental disorders that do not mainly affect abnormal movement patterns and postures cannot be diagnosed as cerebral palsy.

#### **1.2.5. Attributed to**

Refers to genetic, chemical, and other factors that influence brain development. With the rapid development of neurobiology, the understanding of brain structural damage is constantly improving, but many causes are still unclear.

#### **1.2.6. Development**

It is a key feature in the definition of cerebral palsy. The developmental nature of cerebral palsy determines the theoretical basis and methods of intervention. Symptoms of dyskinesia usually appear before 18 months of age.

#### **1.2.7. Fetuses and infants**

Brain damage occurs in the early stages of brain development, well before motor abnormalities manifest, which refers to the fetal period to 2 - 3 years after birth.

#### **1.2.8. Brain**

It refers to movement disorders caused by lesions of the brain, cerebellum, and brainstem, excluding movement disorders caused by lesions of the spinal cord, peripheral nerves, and muscles.

#### **1.2.9. Non-progress**

The events leading to pathological changes in the brain no longer progress, but the clinical manifestations caused by this

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damage change with different developmental processes. Movement abnormalities caused by progressive lesions in the brain are not included in the diagnosis of cerebral palsy.

### **1.2.10. Lesions**

Processes or events that hinder, damage, and affect normal brain development through some pathways, including brain dysplasia, result in permanent (non-progressive) damage to the brain. In some individuals, a specific injury and its timing and mechanism of occurrence cannot be identified.

### **1.2.11. Cause**

Limitation of activity is caused by abnormal movement. Abnormal movements and postures that do not cause limitations in activity are not included in the diagnosis of cerebral palsy.

### **1.2.12. Disorders**

A state (abnormality, disorder) that occurs after a child's normal and orderly neurophysiological development is affected, and this state persists.

### **1.2.13. Simultaneity**

It refers to other abnormalities or injuries that are accompanied by abnormal movements and postures. Because some symptoms can appear independently, they are expressed as accompanying rather than combined.

### **1.2.14. Sensation**

Vision, hearing, and other sensory modalities may be affected.

### **1.2.15. Perception**

The ability to integrate and interpret sensory and/or cognitive information. The damage is not only directly caused

by cerebral palsy, but also related to secondary damage caused by limited experience activities in learning and perceptual development.

### **1.2.16. Cognition**

Overall or specific cognitive processes are affected. Cerebral palsy is generally not diagnosed if there is obvious cognitive retardation without abnormal central motor function.

### **1.2.17. Communication**

Includes expressive and/or receptive communication and social skills.

### **1.2.18. Behavior**

Including behavioral problems in psychiatry, such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), mood disorders, anxiety, and behavioral disorders.

### **1.2.19. Epilepsy**

Children with cerebral palsy can suffer from various types of epilepsy or epilepsy syndromes.

### **1.2.20. Secondary musculoskeletal problems**

Such as muscle/achilles tendon contracture, trunk twisting, hip dislocation, spinal deformity, etc. Many of the problems persist throughout life and are related to factors such as growth, muscle spasms, and aging in children with cerebral palsy.

## **1.3. The meaning of the definition**

Abnormal motor development and posture are the core manifestations of cerebral palsy, and clinical rehabilitation treatment and research should focus on solving the motor

dysfunction of children with cerebral palsy. The essential feature in the definition of cerebral palsy is limited development and activity, and developmental and secondary symptoms should be fully considered Sexual muscle, bone and other problems. The definition is more in line with the core elements of ICF, which cover the physical functions and structures of children with cerebral palsy, as well as activities, participation, and environmental factors. It evaluates the functions of children with cerebral palsy at the physical, individual, and social levels (Francés et al.,2022).

**Recommendation:** The definition of cerebral palsy accurately and comprehensively explains the nature and characteristics of cerebral palsy. Recommended applications (expert consensus).

## **2. Clinical classification and grading of cerebral palsy (Chukwukere,2018)**

### **2.1. Clinical classification**

#### **2.1.1. Spastic quadriplegia**

Mainly damage to the pyramidal system, including damage to the cortical motor area. Hyperactive stretch reflexes are characteristic of this type. Increased muscle tone of the limbs, dorsiflexion, adduction, and internal rotation of the upper limbs, adduction of the thumbs, forward flexion of the trunk, adduction, internal rotation, and cross-over of the lower limbs, knee flexion, scissor steps, pointed feet, foot varus, sitting with an arched back, Tendon hyperreflexia, ankle clonus, pyramidal tract sign, and jackknife sign during muscle tone examination.

#### **2.1.2. Spastic diplegia**

Symptoms are the same as those of spastic quadriplegia, with the main manifestations being spasms and dysfunction of

the lower limbs which are more severe than those of the upper limbs.

### 2.1.3. Spastic hemiplegia

Symptoms are the same as those of spastic quadriplegia, manifesting on one limb.

### 2.1.4. Dyskinetic

Main damage to the extrapyramidal system, mainly including (1) chorea; (2) athetosis; (3) chorea-athetosis; and (4) dystonia. The most obvious feature of this type is the asymmetrical posture or involuntary movement of the head and limbs, that is, a certain movement is often mixed with many unnecessary movements, and the limbs and head keep shaking, making it difficult to control oneself. This type of muscle tone can be high or low and can change with age. Tendon reflexes were normal and extrapyramidal signs were positive, such as the tonic labyrinthine reflex (TLR) (+) and the asymmetrical tonic neck reflex (ATNR) (+). The muscle tone is low at rest and increases during voluntary movement. It is sensitive to stimulation, has strange expressions, winking, neck instability, articulation and articulation disorders, salivation, and difficulty eating. It is often characterized by low muscle tone in infancy.

### 2.1.5. Ataxia type (ataxia)

The main damage is to the cerebellum, which may involve the pyramidal system and the extrapyramidal system. The main characteristic is uncoordinated movements caused by impairments of motor sense and balance sense. To obtain balance, the left and right feet are far apart, resulting in a staggering gait and poor directionality. Clumsy and uncoordinated movements, intentional tremors and nystagmus, balance disorder, the center of gravity on the heel when standing, wide base, drunken gait, and body stiffness. Muscle tone may be low, movement speed may be slow, head

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movement may be limited, and separation movements may be poor. Difficulty standing with eyes closed (+), finger-nose test (+), and normal tendon reflexes.

### 2.1.6. Worster-Drought syndrome

It is a type of cerebral palsy characterized by congenital pseudobulbar (supra bulbar) paresis, which manifests as selective muscle weakness of the lips, tongue, and soft palate, dysphagia, dysphonia, salivation, and mandibular twitching (te Velde et al.,2019)

### 2.1.7. Mixed types

**CP has the characteristics of more than two types.**

**Recommended clinical classification:** spastic quadriplegia, spastic diplegia, spastic hemiplegia, involuntary movement type, ataxia type, Worster-Drought syndrome, mixed type. Recommended applications (expert consensus).

## 2.2. Motor function classification

The gross motor function classification system (GMFCS) was used to evaluate the degree of motor dysfunction in children with cerebral palsy. GMFCS is a grading system designed based on the age-related changes in motor function limitations of children with cerebral palsy. It is one of the main bases for the degree of motor dysfunction in cerebral palsy. The GMFCS grading system divides children with cerebral palsy into 5 age groups (0~2 years old, 2~4 years old, 4~6 years old, 6~12 years old, and 12~18 years old). Each age group is ranked from highest to lowest according to its motor function. Divided into 5 levels (Level I, Level II, Level III, Level IV, and Level V), GMFCS is more accurate in determining the degree of motor dysfunction in children with cerebral palsy aged  $\geq 2$  years (Sadowska et al.,2020)

**Recommended clinical grading:** GMFCS is used, divided into 5 age groups, and each age group is divided into 5 levels—recommended applications (expert consensus).

### **3. Auxiliary examination for cerebral palsy**

#### **3.1. Directly related inspections**

Cranial imaging examinations, including magnetic resonance imaging (MRI), and computed tomography (CT).

- 1) Brain MRI helps detect neuroanatomical abnormalities in the motor areas of the brain, which is beneficial to the diagnosis and classification of cerebral palsy, with a sensitivity of 86% to 89%. The main characteristics are spastic hemiplegia: unilateral focal vascular damage, malformation, cerebral hemorrhage, white matter lesions, cerebral infarction, etc.; spastic diplegia: bilateral white matter damage, cystic periventricular leukomalacia, internal capsule posterior limb spinal cord Scarcity or lack of sheaths, moderate to severe white matter damage, etc.; spastic quadriplegia: gray matter damage, malformation, cystic periventricular leukomalacia and lack of myelin in the hind limbs of the internal capsule, severe white matter damage or the absence of deep gray matter nuclei, etc.; involuntary motor type: damage to the lentiform nucleus of the thalamus, gray matter damage, etc.; ataxic type: damage to the cerebellum, malformation, etc.
- 2) Cranial imaging examinations help judge the prognosis of cerebral palsy. For example, cerebral palsy that cannot walk may occur due to parenchymal hemorrhage on both sides of the brain, bilateral cystic periventricular leukomalacia, severe brain dysplasia, and severe damage to the basal ganglia; cerebral palsy that can walk may occur from parenchymal damage, hemorrhage, or perinatal damage to one side of the brain. Stage 1 arterial ischemic injury, periventricular leukomalacia (non-cystic), moderate to

severe white matter injury, or minor damage to both sides of the brain. Normal cranial neuroimaging results do not exclude the risk and diagnosis of cerebral palsy. The resolution of head MRI is higher than that of head CT (Fatima et al,2024)

**Recommendation:** (1) Brain imaging (MRI, CT) is a strong support for the diagnosis of cerebral palsy, and MRI is superior to CT in etiological diagnosis. Recommended applications (expert consensus). (2) Cranial imaging examination can help with etiology analysis, clinical diagnosis, and prognosis analysis of cerebral palsy—recommended applications (expert consensus).

### 3.2. Related examinations of accompanying symptoms and comorbidities

Children with cerebral palsy are often accompanied by other accompanying symptoms and comorbidities, including intellectual development disabilities, epilepsy, language disorders, visual impairments, and hearing impairments (Himmelman et al.,2021)

#### 3.2.1. Electroencephalogram (EEG)

Those with a history of convulsions must undergo an EEG examination. EEG examinations may also be performed if there is developmental delay, a history of suspected convulsive attacks, and neonatal cerebral infarction. EEG background waves can help determine brain development. EEG can be used as a bedside diagnostic test for cerebral infarction in newborns, and can more reliably predict their neuromotor development. However, EEG is not used as a routine examination item for the diagnosis of cerebral palsy (Ballester-Plané et al.,2017)

**Recommendation:** EEG can help diagnose epilepsy, and help determine brain development and neonatal cerebral infarction. Recommended applications (expert consensus)

### 3.2.2. Electromyogram (EMG)

EMG can distinguish myogenic or neurogenic paralysis, and identify upper and lower motor neuron injuries, spinal cord diseases, etc. EMG can also evaluate the effect of Botulinum toxin type A (BTX-A) in the treatment of spastic cerebral palsy. Wearable electromyography recorders can be used to measure differences in muscle activity during daily activities in children with cerebral palsy. Free-running electromyography Figures can help determine the extent of severing during selective dorsal rhizotomy/selective posterior rhizotomy (SDR/SPR), which has important clinical significance (Bosenbark et al.,2017)

**Recommendation:** EMG can help identify myogenic or neurogenic paralysis, upper and lower motor neuron damage, and spinal cord disease, as well as evaluate the efficacy of BTX-A and help determine the scope of severing in SDR/SPR. Recommended applications (expert consensus)

### 3.2.3. Listening and visual assessment

Those with suspected hearing impairment need to undergo brainstem auditory evoked potential (BAEP) and related examinations, which are of great significance for early screening and early intervention of newborn hearing impairment; those with suspected visual impairment should undergo brainstem auditory evoked potential (BAEP) and related examinations. Brainstem visual evoked potential (VEP) and/or fundus examination, combined with neurophysiological examination, have better value (Delin et al.,2020)

**Recommendation:** If hearing impairment is suspected, it is recommended to undergo BAEP and related examinations; if visual impairment is suspected, VEP and/or fundus examination

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is recommended. Recommended applications (expert consensus.)

### 3.2.4. Intelligence and language-related examinations

Those who have developmental abnormalities or functional impairments such as intelligence, language, nutrition, growth, swallowing, daily living abilities, communication abilities, and eating abilities need to undergo IQ/developmental quotient, language, nutrition, growth, swallowing, daily living abilities, communication abilities, etc. Assessment (Delin et al.,2020)

### 3.2.5. Examination of inherited metabolic diseases

Atypical cerebral palsy can be treated with genomic analysis or genetic metabolic examination to help make an accurate diagnosis (Nagy et al.,2020)

**Recommendation:** Routine genomic analysis and genetic metabolic examinations are not recommended for children with cerebral palsy. Recommended applications (expert consensus).

### 3.3. Motor function and neurodevelopmental assessment

- 1) Gross motor function measure (GMFM) is suitable for 0 to 5 years old; GMFCS is suitable for 0 to 18 years old, and the results are more accurate after 2 years old.
- 2) The fine motor function measure scale (FMFM) and the manual ability classification system (MACS) are suitable for ages 4 to 18.
- 3) Assessment of general movements (GMs) is of high value in predicting the development of spastic cerebral palsy in high-risk children with cerebral palsy. It can assess whether high-risk children will develop spastic cerebral palsy with a sensitivity of 98%. It is suitable for

babies with a corrected age of less than 5 months (Nagy et al.,2020).

- 4) Hammersmith infant neurological examination (HINE) can be easily scored and quantified. Each item is scored from 0 to 3 points, with a total score of 78 points. Infants with a score of 73 or above are considered normal. Infants with a score of 57 to 73 corrected before 5 months of age and 40 to 73 points from 5 months to 2 years of age can be diagnosed as infants at high risk of cerebral palsy (IHRC). A corrected score of less than 57 points before 5 months of age and a corrected score of less than 40 points from 5 months to 2 years old can be used as the basis for diagnosing cerebral palsy. The results are highly correlated with GMFCS, with a sensitivity of 90%. Suitable for infants and young children from 2 months to 2 years old [23].
- 5) Other commonly used infant motor and neurodevelopment assessments: Peabody Developmental Motor Scale (PDMS), Alberta Infant Motor Scale (AIMS), Infant Motor Performance Test of Infant Motor Performance (TIMP), developmental assessment of young children (DAYC), neurosensory motor development assessment (NSMDA), motor assessment of infants (MAI) ) scale(Olga et al.,2024).

### **Recommendation:**

- 1) GMs are suitable for babies under 5 months of corrected age. Recommended applications (expert consensus).
- 2) HINE is suitable for infants and young children from 2 months to 2 years old—recommended applications (expert consensus).
- 3) GMFM is suitable for 0~5 years old; GMFCS is suitable for 0~18 years old, and the results are more

accurate after 2 years old—recommended applications (expert consensus).

- 4) Other commonly used infant motor and neurodevelopment assessment scales include PDMS, AIMS, TIMP, DAYC, NSMDA, MAI, etc. Recommended applications (expert consensus).

#### **4. Diagnosis and differential diagnosis of cerebral palsy**

##### **4.1. Diagnosis**

Diagnosis should be based on neurological examination, motor function assessment, and comprehensive judgment concerning clinical history, neuroimaging, and biological indicators. Progressive diseases need to be excluded (Hoei-Hansen et al.,2023)

##### **4.1.1. Necessary conditions**

##### **4.1.1. Persistence of central dyskinesia**

In infants and young children, gross motor dysfunction and fine motor dysfunction such as lifting, turning over, sitting, crawling, standing, and walking occur in the early (immature stage) of brain development, or significant developmental delays. Functional impairment is persistent and non-progressive, but it is not static. Mild symptoms may gradually alleviate, while severe symptoms may gradually worsen, and may eventually cause secondary damage to muscles and joints (Hoei-Hansen et al.,2023).

##### **4.1.1.2. Abnormal development of movement and posture**

Postural abnormalities in different postures, including dynamic and static, prone, supine, sitting, and standing positions, should be judged based on the postural development

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characteristics of different age groups. Abnormal movement patterns occur during exercise.

#### **4.1.1.3. Abnormal muscle tone and strength**

The muscle strength of most children with cerebral palsy is reduced; the muscle tone of spastic cerebral palsy is increased, and the muscle tone of involuntary cerebral palsy fluctuates (increases when excited or moving, decreases when quiet). It can be judged by checking tendon reflexes, resting muscle tone, postural muscle tone, and exercise muscle tone. It is mainly determined by checking muscle hardness, palm flexion angle, femoral angle of both lower limbs, popliteal fossa angle, limb movement range, joint extension, foot dorsiflexion angle, scarf sign, and heel-to-ear test.

#### **4.1.1.4. Abnormal reflex development**

The main manifestations include delayed disappearance of primitive reflexes and delayed appearance or absence of upright reflexes (such as protective stretch reflexes) and balance reactions. Pathological reflexes may be positive.

#### **4.1.2. Reference conditions**

**4.1.2.1. There is evidence of the etiology of cerebral palsy (preterm birth, low birth weight, hypoxic-ischemic encephalopathy, bilirubin encephalopathy, intrauterine infection)**

**4.1.2.2. Cerebral magnetic resonance imaging (MRI) evidence.**

**Recommendation:** The diagnosis of cerebral palsy should meet the above four necessary conditions, and the reference conditions can help find the cause. Recommended applications (expert consensus)

### 4.1.3. Early prediction of cerebral palsy

#### 4.1.3.1. *Corrected age <5 months*

- 1) MRI, the sensitivity is 80%~90%;
- 2) GMs, the sensitivity is 95%~98%, the main manifestations are restless lack of movement, monotonic GMs, spastic-synchronic GMs, and chaotic GMs;
- 3) HINE, the sensitivity is 90%~96%, and the score is <57 points;
- 4) TIMP reflects the status of motor development.

#### 4.1.3.2. *Corrected age>5 months*

- 1) MRI, sensitivity is 80%~90%;
- 2) HINE, sensitivity is 90%, score <40 points;
- 3) DAYC, sensitivity is 89%;
- 4) AIMS, sensitivity is 86 %;
- 5) NSMDA, the sensitivity is 82%;
- 6) MAI, the sensitivity is 73%.

#### **Recommendation:**

- 1) The best solution for predicting cerebral palsy at a corrected age <5 months is GMs+MRI, and the alternative is HINE+TIMP. Recommended applications (expert consensus).
- 2) The best solution for predicting cerebral palsy at a corrected age of >5 months is HINE+MRI+motor assessment, and the alternative is HINE+motor assessment. Recommended applications (expert consensus)

### 4.1.4. IHRCP provisional diagnosis

With mild motor function abnormalities, a mild abnormality in neurodevelopmental evaluation, abnormal cranial imaging, and a high-risk history of cerebral palsy, the patient does not yet meet the diagnostic criteria for cerebral palsy. The risk of cerebral palsy is much higher than that of ordinary infants and young children and can be temporarily diagnosed as IHRCP can provide specific intervention according to cerebral palsy intervention methods, which can prevent the development of cerebral palsy or reduce the degree of functional impairment.

#### **4.1.4.1. Necessary conditions**

##### **Movement dysfunction and decreased movement quality.**

- 1) GM's assessment results are abnormal.
- 2) Nervous system abnormalities (clinical manifestations + HINE score): 57-73 points for corrected months of age <5 months, 40-73 points for corrected months of age between 5 months and 2 years.
- 3) Retarded or abnormal motor development: Abnormal standard motor assessment scores or observed delayed motor development.
- 4) Be alert to the presence of atypical manifestations: the normal range of standardized movement assessment can be reached, but abnormal movements are also present.

#### **4.1.4.2. Additional conditions**

##### **Neuroimaging abnormalities and high-risk history of cerebral palsy.**

- 1) Neuroimaging (MRI) abnormalities: such as white matter lesions, cortical or deep gray matter lesions, malformations, etc.;

2) High-risk history of cerebral palsy: such as premature birth, low birth weight, hypoxic-ischemic encephalopathy, bilirubin encephalopathy and

**Recommendation:** The temporary clinical diagnosis of IHRCP must meet the necessary conditions for motor dysfunction and at least one additional condition. Recommended applications (expert consensus).

#### 4.2. Differential diagnosis

It is mainly distinguished from the following diseases or dysfunctions (Harniess et al.,2022)

##### 4.2.1. Retarded motor development and neurodevelopmental disorders

###### 4.2.1.1. Developmental delay/delayed milestone (DD)

DD means that one of the iconic developmental indicators/milestones (such as sitting, standing, walking, language, etc.) in infants and young children's movement, language, or cognition has not reached the level expected for the corresponding age group. The latest research suggests that DD should also include changes and lags in sleep patterns. DD is a temporary, transitional, symptom-descriptive diagnosis suitable for infants and young children.

###### 4.2.1.2. Temporary intellectual developmental disorder (PIDD)

Intellectual development disorder (developmental quotient <70 points), the individual is an infant or a child under 4 years old, or the individual suffers from sensory or physical impairment (such as blindness, prelingual deafness), movement disorder, severe problem behavior, or concurrent mental behavioral disorder. Inability to make effective evaluators of intellectual functioning and socially adaptive behavior. The

International Classification of Diseases (ICD)-11 uses PIDD to replace the name of global developmental delay (GDD).

#### **4.2.1.3. Developmental coordination disorder (DCD)**

- 1) The acquisition and execution of motor coordination are lower than the motor skills that normal children of the same age should acquire, and the movements are clumsy, slow, and imprecise.
- 2) This motor disorder will continue to significantly affect daily life, studies, work, and even Entertainment;
- 3) The disorder appears early in development.
- 4) The lack of motor skills cannot be explained by intellectual development disorder or visual impairment; nor is it a movement disorder caused by cerebral palsy, muscular dystrophy, degenerative diseases, etc.

#### **4.2.1.4. ASD**

- 1) Current or past deficits in social communication and social interaction in persistent multiple situations.
- 2) Restricted and repetitive abnormal patterns of behavior, interests, or activities.
- 3) Symptoms appear early in development.
- 4) The symptoms lead to very severe functional deficits in many important areas of society.
- 5) The deficits cannot be explained by PIDD. When PIDD and ASD coexist, social communication skills are usually lower than the level of intellectual disability.

#### **4.2.2. Bone diseases**

##### **4.2.2.1. Developmental dysplasia of the hip (DDH)**

It is a disease caused by factors such as genetics, breech birth, leg binding, and other factors that cause unilateral or

bilateral hip joint instability and poor alignment of the femoral head and acetabulum. His intelligence and upper limb motor functions are normal but he has difficulty standing. Diagnosis can be made concerning hip ultrasound, pelvic X-rays, CT and MRI.

#### **4.2.2.2. Congenital laxity of ligament**

Gross motor development is delayed, walking alone is delayed, unsteady, easy to fall, and difficult to go up and down stairs, joint range of motion is significantly increased and hyperextension, adduction or abduction, normal muscle strength, normal tendon reflexes, no pathological reflexes, and no convulsions, normal intelligence, may have a family history, symptoms gradually improve with age.

#### **4.2.3. Spinal cord diseases**

Poliomyelitis and lower limb paralysis left by myelitis should be excluded; spinal cord MRI should be performed if necessary to rule out syringomyelia, compressive myelopathy, and spinal muscular atrophy.

#### **4.2.4. Endocrine diseases**

Congenital hypothyroidism is characterized by low physiological functions such as hyporesponsiveness, low crying, low body temperature, slow respiratory pulse, intellectual development retardation, and hypotonia. It can be identified by special facial appearance, decreased serum-free thyroxine, increased thyroid-stimulating hormone, and delayed bone age.

#### **4.2.5. Autoimmune diseases**

Multiple sclerosis (MS) is an autoimmune disease mainly characterized by inflammatory demyelinating lesions in the white matter of the central nervous system. The scattered

distribution of multiple lesions in the white matter is associated with remission and recurrence during the disease, spatial multiplicity of symptoms and signs, and temporal multiplicity of the disease course. Early manifestations: (1) body weakness; (2) significantly less kicking movements; (3) abnormal gait when walking; (4) bilateral movement asymmetry; (5) inability to grasp accurately.

#### 4.2.6. Common genetic diseases

Some genetic diseases include movement disorders, abnormal posture, changes in muscle tone and strength, and are easily misdiagnosed as cerebral palsies, such as familial (hereditary) spastic paraplegia (FSP), Pelizaeus-Merzbacher disease, PMD), Kabuki syndrome, spinocerebellar ataxia (SCA), myotonic muscle dystrophy, Duchenne muscle dystrophy (DMD), infantile form Progressive spinal muscular atrophy (SMA), metachromatic leukodystrophy (MLD), adrenoleukodystrophy (ALD), dopa-responsive dystonia), glutaric aciduria type I, Rett syndrome, GM1 gangliosidosis type I, Niemann-Pick disease type C -Pick disease type C) and mitochondrial myopathy (mitochondrial myopathy), etc. The above genetic diseases need to be diagnosed based on typical clinical characteristics, chromosomal, genetic, and blood and urine metabolism tests.

**Recommendation:** Developmental retardation, neurodevelopmental disorders, skeletal diseases, spinal cord diseases, endocrine diseases, autoimmune diseases, and genetic diseases should be excluded from the diagnosis of cerebral palsy. Recommended applications (expert consensus).

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