# CEREBRAL PALSY: An Integrated Approach

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# WHAT IS CEREBRAL PALSY?

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# Modern consensus definition:

- Group of disorders of movement and posture
- Non-progressive etiology
- Damage to the fetal or infant brain

- Often accompanied by co-occurring problems with sensation, perception, communication, and/or behavior and/or seizure disorder

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# WHAT IS CEREBRAL PALSY?

Diagnosis of Cerebral Palsy has 4 requirements:

1. Non-progressive impairment
2. Immature or developing
3. Brain *(cerebral)*

4. Abnormal motor development *(palsy)*

# DIAGNOSIS: Non-progressive

Excludes conditions which cause ongoing brain injury over time: neurodegenerative disorders

Also excludes conditions which resolve

# DIAGNOSIS: Non-progressive

However, symptoms can transform through the life span even when the primary brain injury has not worsened or improved since birth

*CP is non-progressive, but not unchanging*

# DIAGNOSIS:
# Immature or developing brain

When does development end?

- Embryonic formation of organs
- Birth
- 1 year: common end point for CP diagnosis
- 2-3 years:  Brain myelination completed
- 7-9 years:  Maturation of motor skills
- 16-18 years:  Physical maturity
- Social maturity






# DIAGNOSIS:
# Immature or developing brain

*Brain injury causing cerebral palsy usually occurs before birth or shortly after…*

*…and sometimes we do not know when it happens.*

# DIAGNOSIS: Immature brain

Presentation of symptoms in CP:

- Sometimes noted right after birth
- Typically by 6-12 months
- Mild cases may not be noticed until 12-18 months

# DIAGNOSIS:
# Brain impairment

Excludes motor problems from diseases of:

| | EXAMPLES |
|---|---|
| Spinal cord | Spina bifida |
| Muscles | Muscular dystrophy |
| Nerves | Spinal muscular atrophy |

# DIAGNOSIS: Etiology

Includes many causes of early brain injuries:

| | |
|---|---|
| PVL | Brain damage with prematurity |
| Birth hypoxia | Lack of oxygen to whole brain |
| Brain malformation | Abnormal pattern of cell growth |
| Prenatal stroke | Blood supply interruption |
| Encephalitis | Brain infection, reaction to infection |
| Hyperbilirubinemia | Jaundice |
| Other | |

# DIAGNOSIS: Etiology

I

*Can be caused by a combination of factors*

*Occasionally the factors are never known*

# DIAGNOSIS: Etiology

Most common etiology:

Complex series of events in the brain set in motion after birth among newborns with prematurity and very low birth weight

Currently largest single etiology of cerebral palsy

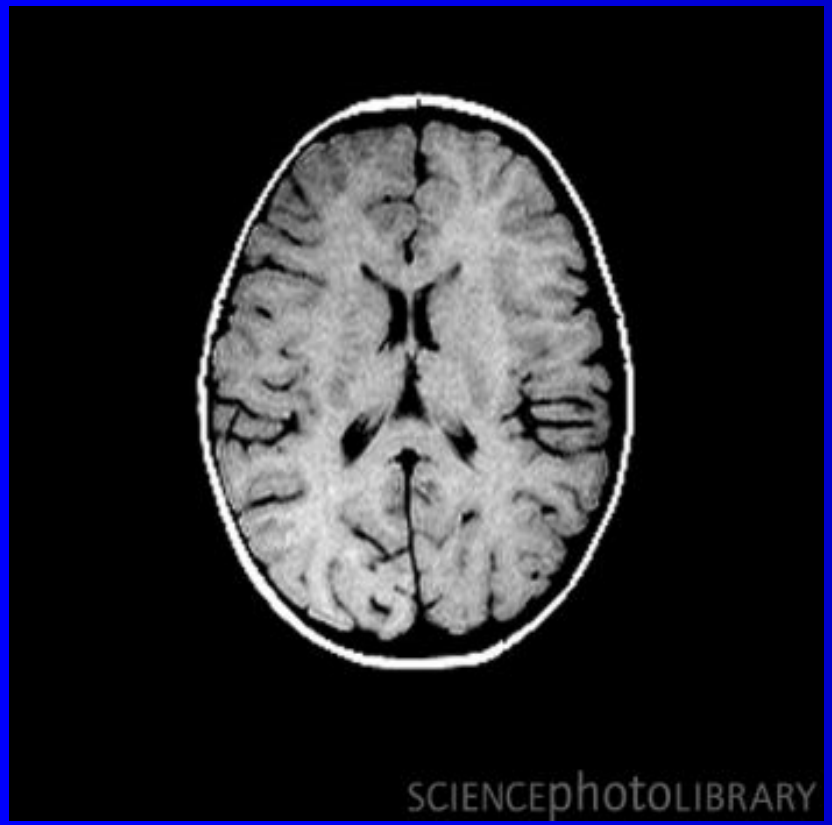
# DIAGNOSIS: Etiology

Prematurity and low birth weight associated with PERIVENTRICULAR LEUKOMALACIA:

| | | |
|---|---|---|
| Peri | = | around |
| Ventricular | = | deep brain fluid spaces |
| Leuko | = | white matter |
| Malacia | = | thinning |

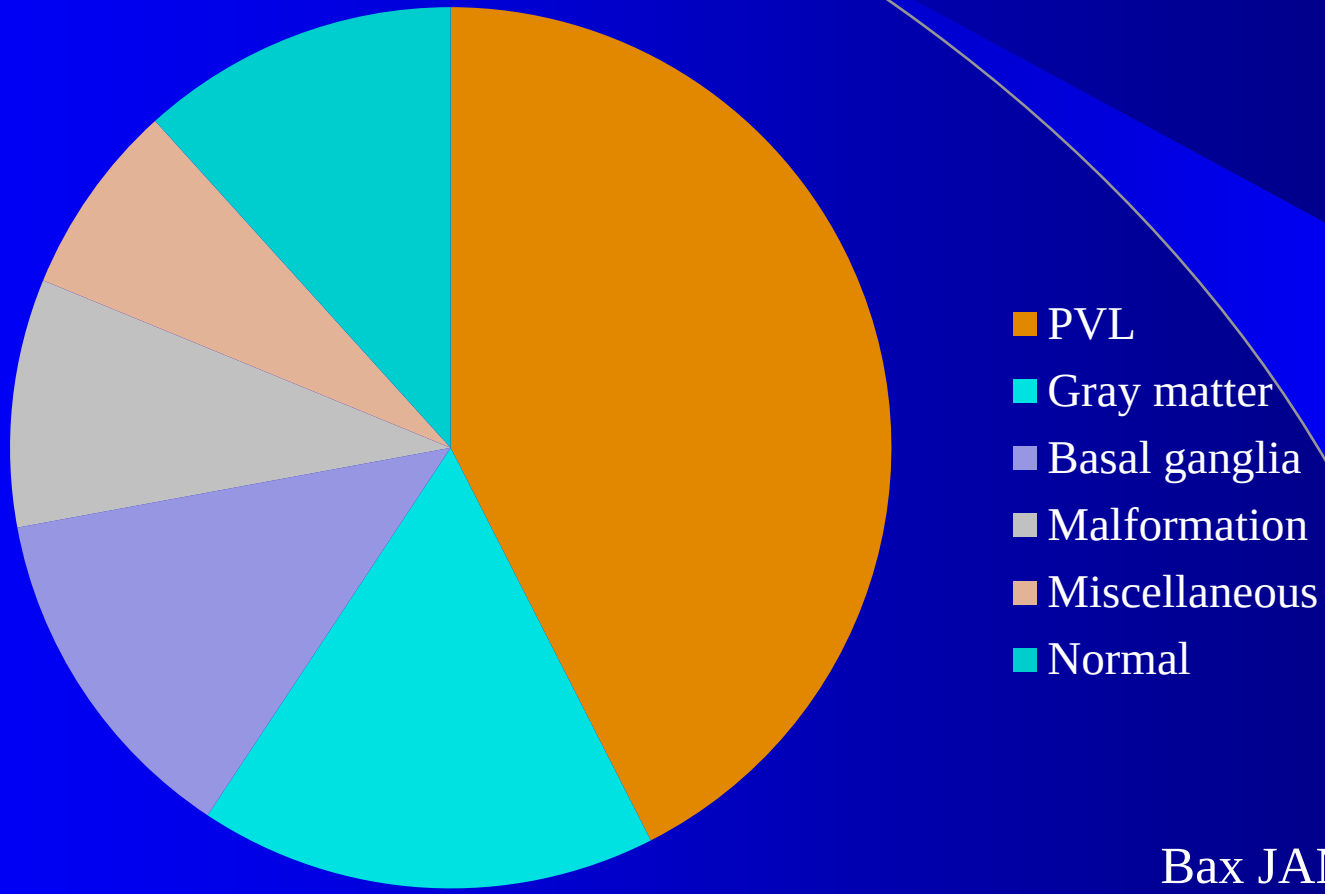
# DIAGNOSIS:
# MRI with Periventricular leukomalacia

Normal brain




PVL

# Cerebral Palsy: Cranial imaging findings

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# DIAGNOSIS:
# Disturbance of motor development

CP is usually described by type of motor problem



Spastic types most common, and described by distribution

- Quadriplegic: both arms and both legs
- Hemiplegic: Arm and leg on both sides
- Diplegic: Both legs more impaired than both arms

# DIAGNOSIS
## Disturbance of motor development

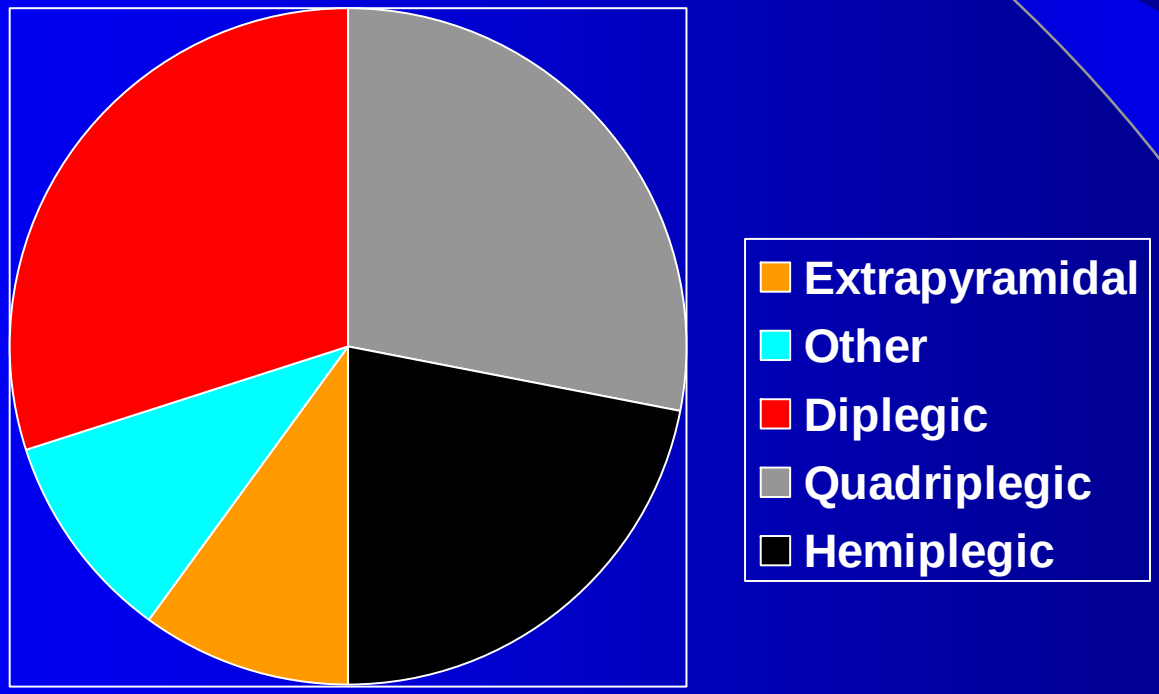
CP is usually described by type of motor problem

Other types:

- Dyskinetic: abnormal involuntary movements
  - Dystonia
  - Athetosis
  - Chorea
- Ataxic: coordination issues

*Many people have more than one movement challenge*

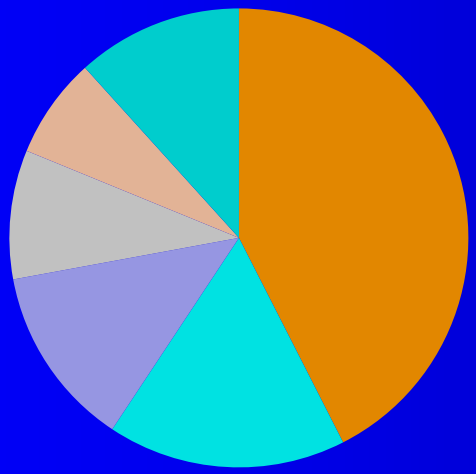
# DIAGNOSIS:
# Types by motor pattern



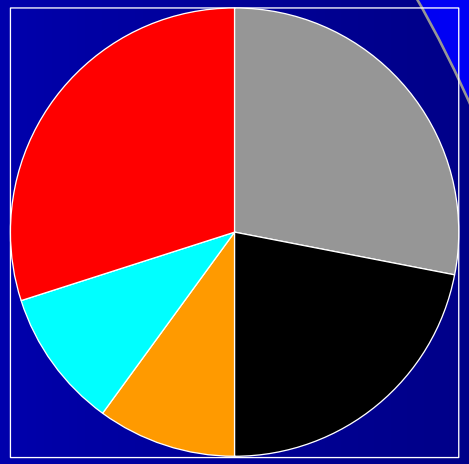
# DIAGNOSIS:
# Disturbance of motor development

There is *partial* correlation between etiology and type of motor problem:

ETIOLOGY



MOTOR TYPE



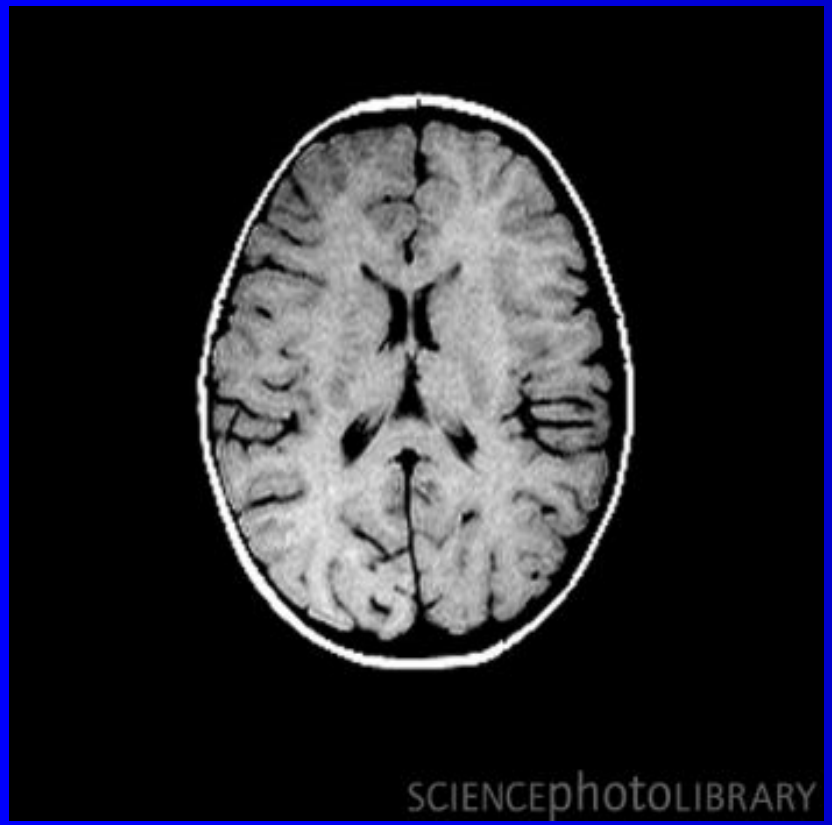
# DIAGNOSIS:
# Disturbance of motor development

There is *partial* correlation between etiology and type of motor problem:

| *MRI abnormality* | *Motor problem* |
| --- | --- |
| PVL | Diplegia |
| Birth Hypoxia | Quadriplegia and dystonia |
| Prenatal stroke | Hemiplegia |

# DIAGNOSIS:
# MRI with Periventricular leukomalacia

Normal brain




PVL

# MOTOR DELAYS: GMFCS
# Gross Motor Classification System

Track curves of motor development in children with CP from early milestones to adult skills achievement.

Predicts general trends at 5 functional levels

# MOTOR DELAYS: GMFCS

Level I: Walks without limitations

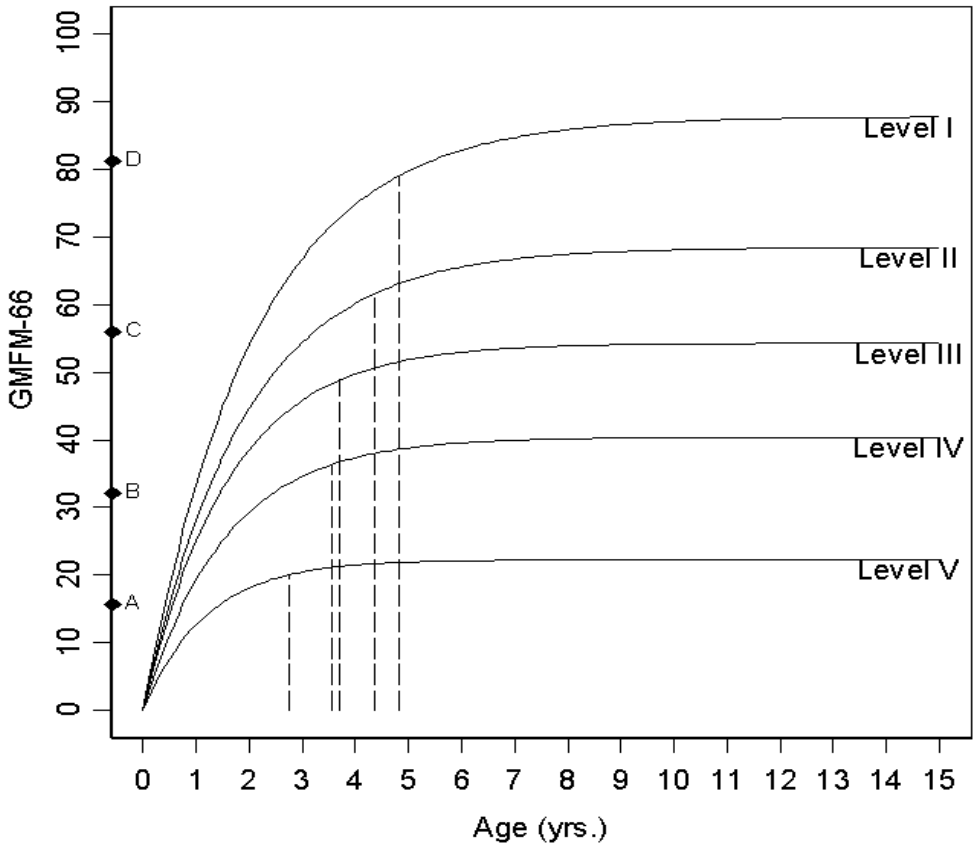
Level II: Walks with limitations

Level III: Ambulation with device only

Level IV: Limited mobility, power wheelchair

Level V: Dependent manual wheelchair

## GMFCS Level I to V




This graph shows the observed and predicted GMFM-66 scores for children in GMFCS Levels I through V. The curved solid lines indicate average performance. The horizontal dotted lines on the right of the figures indicate the band expected to encompass 50% of children's limits of development. The solid vertical lines indicate the average age-90 (the age in years by which children are expected to reach 90% of their motor development potential). The dotted vertical lines indicate the bands expected to encompass 50% of age-90 values around the average. The absence of 50% bands in level IV and level V indicates low variation in age-90 values.

# MOTOR DELAYS: REHABILITATION INTERVENTIONS

- Physical therapy
- Orthopedic surgery
- Spasticity reduction
- Casting/splinting
- Bracing
- Mobility aids


***Help but do not change the GMFCS level (usually)***

# DIAGNOSIS:
# Disturbance of motor development

Required for diagnosis

*CP is not an exclusively motor condition*

# Modern consensus definition:

- Group of disorders of movement and posture
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# CEREBRAL PALSY
# Associated concerns

Cognitive

- Cognitive impairment 40-60%
- Learning disabilities common
- Attention deficit disorder
- Other behavioral challenges
- Language disorders

# CEREBRAL PALSY
# Associated concerns

Sensory abnormalities:

- Hearing loss 7-12%
- Abnormal control of eye motions 20-60%
- Visual impairment overall 80%
- Visuoperceptual abnormality also frequent
- Tactile impairment 50-75%
- Balance system impairment
- Sensory integration challenges

# CEREBRAL PALSY
# Associated medical concerns

Seizures 30-50%

# CEREBRAL PALSY
# Associated medical concerns

Autonomic nervous system also affected:

- Abnormal digestive motility
- Temperature instability and cold or hot limbs
- Sweating changes
- Bladder dysfunction
- Breathing irregularities
- Sleep disorders

# CEREBRAL PALSY
# Associated concerns

Secondary problems: Gastrointestinal

- Swallowing difficulties
- Malnutrition
- Growth delays
- Gastric reflux
- Constipation
- Drooling
- Dental changes

# CEREBRAL PALSY
# Associated concerns

Many orthopedic complications:

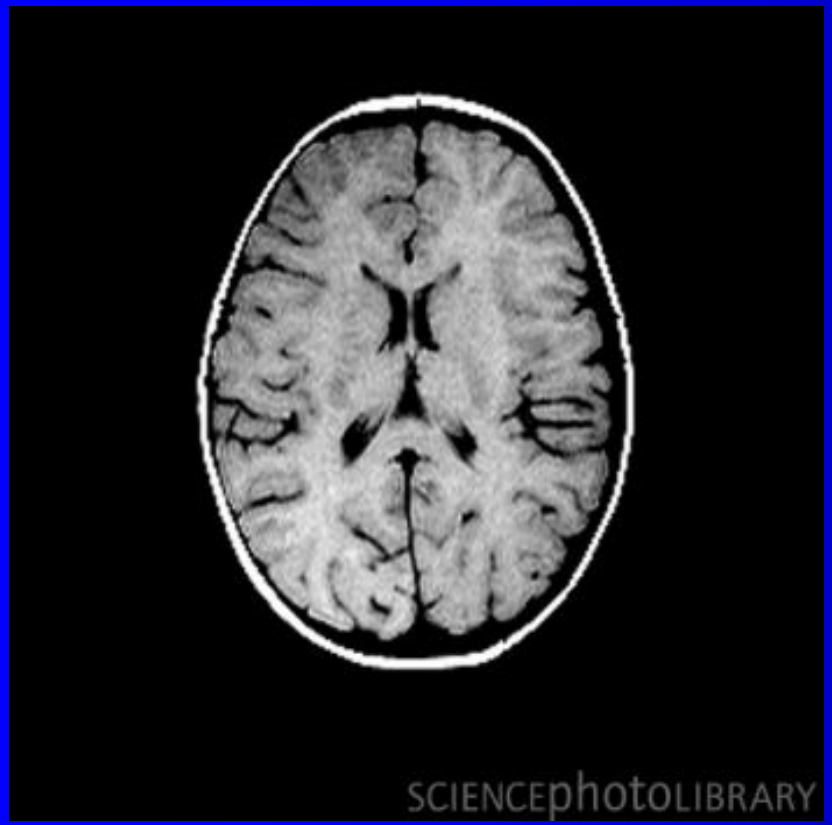
- Abnormal hip growth
- Osteoporosis and fractures (even in children)
- Scoliosis
- Joint limitations
- Musculoskeletal pain

# Combining all of this provides a more complete description of CP:

| | |
|---|---|
| Type: | Spastic |
| Distribution: | Quadriplegic |
| Etiology: | VLBW and prematurity |
| MRI Imaging: | Periventricular leukomalacia |
| Functioning: | GMFCS V |
| Associated: | Cognitive, visual, orthopedic, etc. |

# DIAGNOSIS:
# MRI with Periventricular leukomalacia

Normal brain




PVL

# Cerebral Palsy:
# Goals of an Integrated Approach

REHABILITATION MEDICINE AND CP

Understand the whole person

Address all types of questions

Evaluate unique medical issues with CP