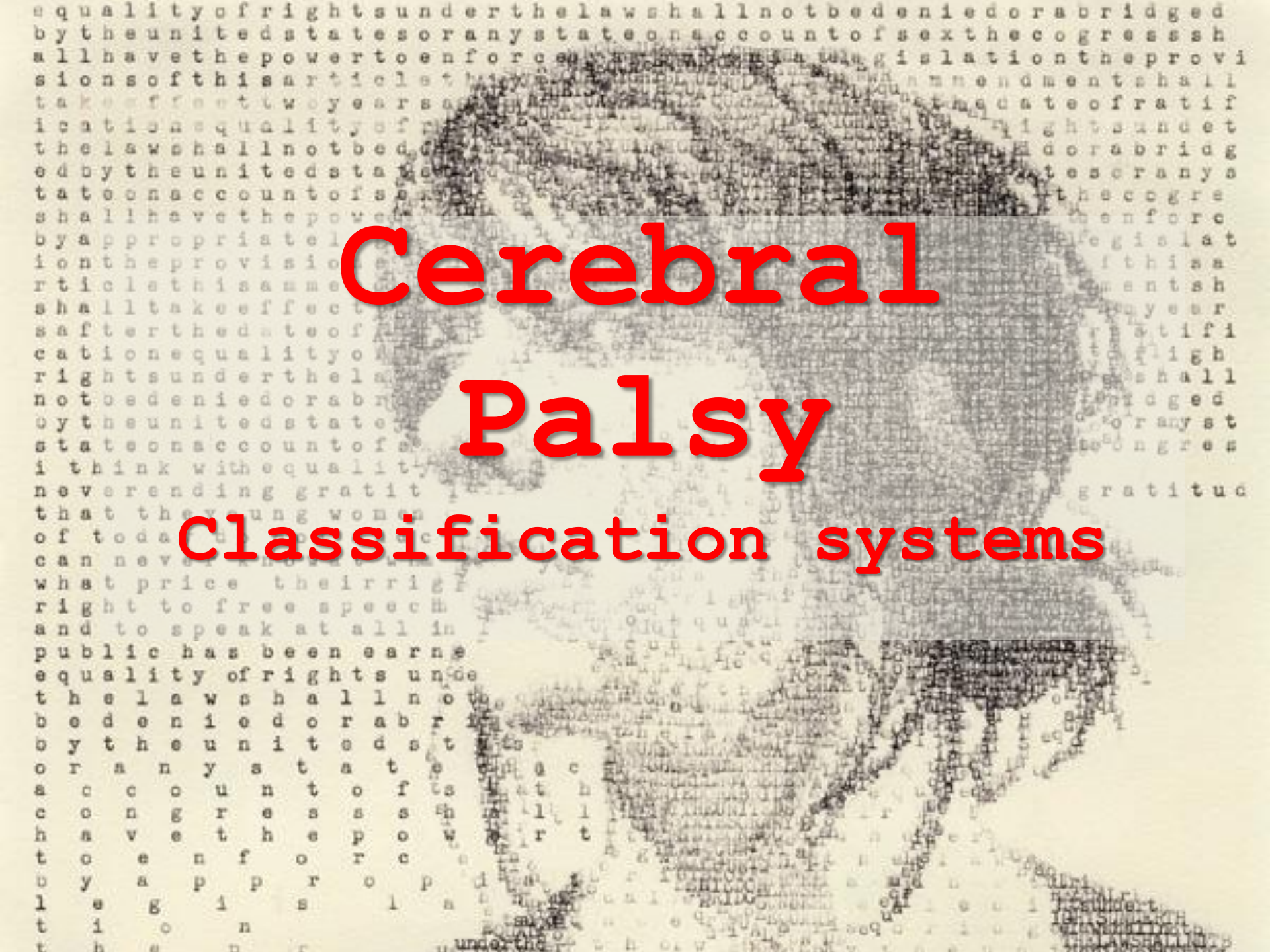

Cerebral
Palsy
Classification systems

Definition CP

- Group of permanent disorders of movement and posture
- Non-progressive disturbances of the developing fetal or infant brain
- Often accompagnied by
  - Disturbances of sensation, perception, cognition, communication and behaviour
  - Epilepsy
  - Secondary musculoskeletal problems

Cerebral Palsy

- The most common cause for physical disability in developed countries
  - 2-4 per 1000

Aetiology

- 10% perinatal hypoxia
- > 1500 grams ⟹ 30 fold risk increase
- Prematurity
- Multiple pregnancy (12% vs 1%)
- Genetic/metabolic disorder (10%)

Maternal risk factors

- Alcohol, drugs,infections (29%), hyperthyroidism, severe toxemia, 3rd trimester bleeding

Aetiology - postnatal

- Head trauma
- Hypoxi/anoxoxia
- Vascular incidents
- Neuro-infections
- Kernicterus

No classification system is useful unless it is reliable !!

CP Classifications

- Motor type – movement disorder
- Topography
- Motorfunction
- Neuro-imaging

Motor type – movement disorder

- Spastic
- Hypotonic
- Dyskinetic
  - Dystonia
  - Athetosis
- Ataxia
- Mixed

Spasticity

- Lesions around the pyramidal system
- Hyperreflexia, Babinski response
- Clonus
- Velocity dependent increase in muscle tone / catch
- Joint contractures are common

Spasticity assessment

0	No catch on rapid passive movement (RPM) (no spasticity).
1	Catch on RPM followed by release. There is no resistance to RPM throughout the rest of the range.
2	Catch occurs in second half of available range (after halfway point) during RPM and is followed by resistance throughout remaining range.
3	Catch occurs in the first half of range (up to and including halfway point) during RPM and is followed by resistance throughout remaining range.
4	RPM is difficult; there is resistance to movement throughout the range.
5	RPM is not possible; body part appears fixed in flexion or extension during RPM but moves when passive movement is slow.

Hypotonic

- Tone may be fluctuating
- Tone may change with time
- 2-3 years hypotonic to hypertonic (myelination)

Dystonic

- Damage to basal ganglia
- Hypokinetic and hypertonia
- Abnormal postures due to prolonged contractions
- Distorted voluntary movements

Athetoid

- Damage to basal ganglia
- Hyperkinetic and hypotonia
- Constantly changing movements

Ataxic

- > 50% with normal MRI findings
- Loss of orderly coordination
- Overshooting
- Tremor
- Poor balance
- Low tone

Mixed

- Should be classified to the most dominant feature
- Fx spasticity often with dystonic features

Topography

- Unilateral (Hemiplegia)
  - Focal traumatic, vascular or asymmetric infectious lesion
  - Epilepsy
  - Hemianopsia
  - Asymmetrical limb growth
  - Functional walking in 90%

Topography

- Bilateral (Tetraplegic)
  - Floppy baby
  - Global involment
    - Bulbar dysfunction; drooling, dysarthria, dysphagia
    - Mental retardation
  - Seizures
  - Functional walking in 10%
  - Hip dislocation, scoliosis (20%)

Topography

- Bilateral (Diplegia)
  - Dominant involment of lower extremity
  - Most have walking abilities (60%)
  - Less often seizures, scoliosis and hip dislocation
  - 1/3 of patients
  - Not very good defined

CP subtypes

- Spastic hemiplegia (25%)
- Spastic diplegia (35%)
- Spastic quadriplegia (20%)
- Ataxia(3%)
- Dyskinetic (15%)
  - Athetoid
  - Dystonic
- Mixed (2%)
  (spastic/dyskinetic/ataxic)

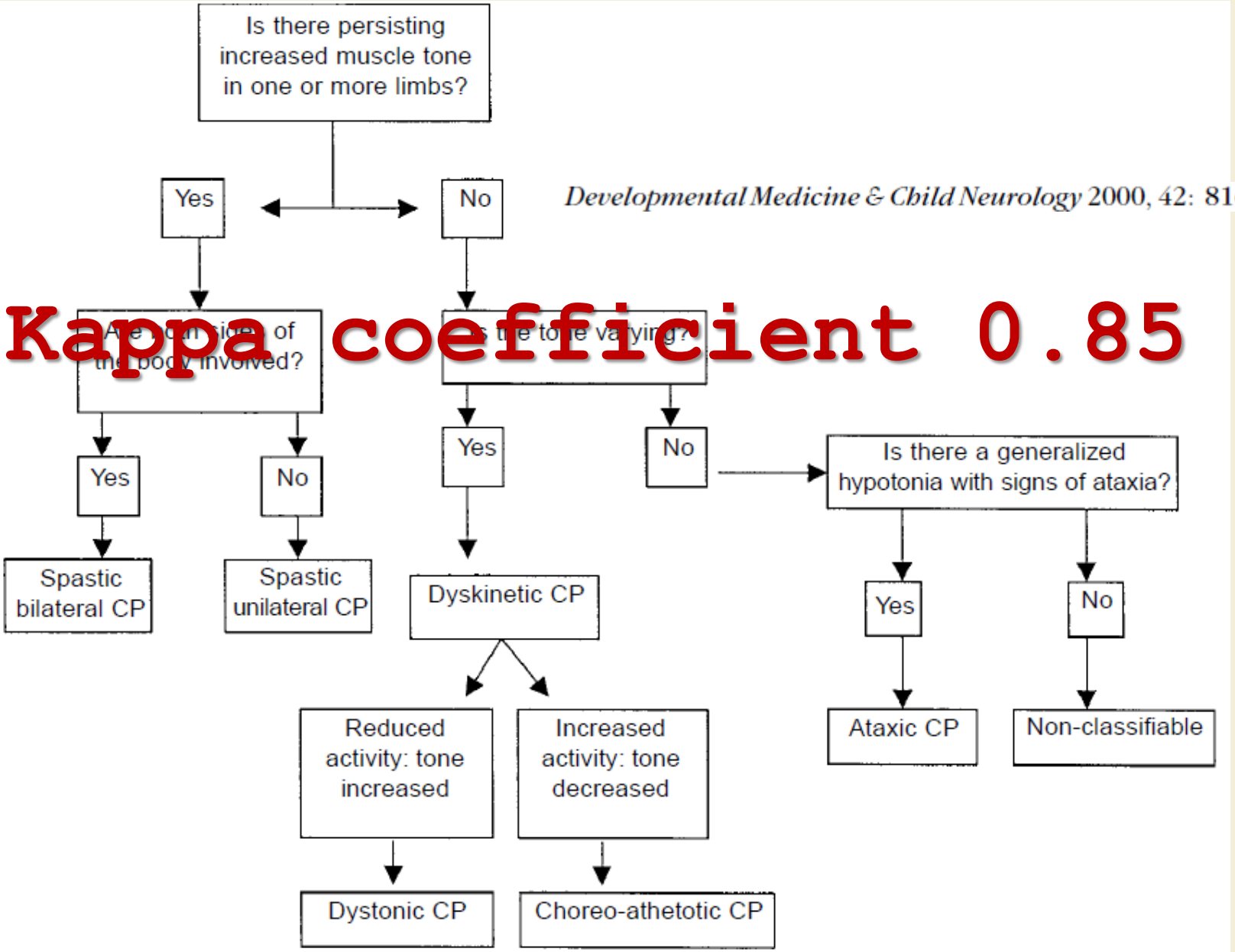
Blair et al. Dev Med Child Neurol , 1985; 27: 615–22.

CP subtypes

- Interrater: Poor to moderate kappa values
- Problematic
  - Diplegia vs tetraplegia
  - Unilateral vs bilateral
  - Mixed patterns
- CP-subtype may be difficult before 4 years of age
- If subtypes reduced – better interobserver agreement

Blair E et al. Interobserver agreement in the classification of cerebral palsy. Dev Med Child Neurol 1985; 27: 615–22.

The SCPE classification



Associated impairments

- Intellectual impairment
- Visual impairment
  - 30% hemiplegic
  - 40% diplegic
  - 60% quadriplegic
- Audio impairment (7%)
- Epilepsy (30%)
  - 50% in quadriplegic
- Psychological/autism

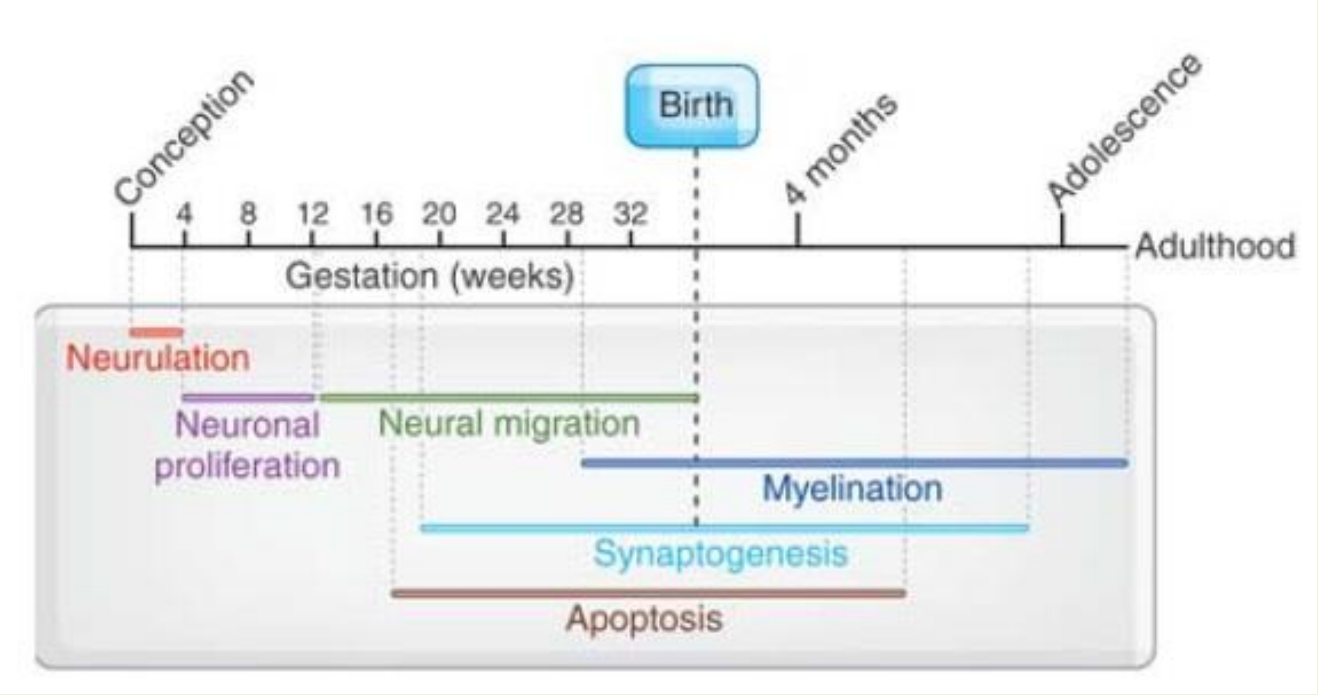
MRI


It's really not about catching fish ...
It's about hanging out ...
... and just getting away
from it all for a bit ...
WHAT!?!?
wumo.com

Brain development

1st trimester:

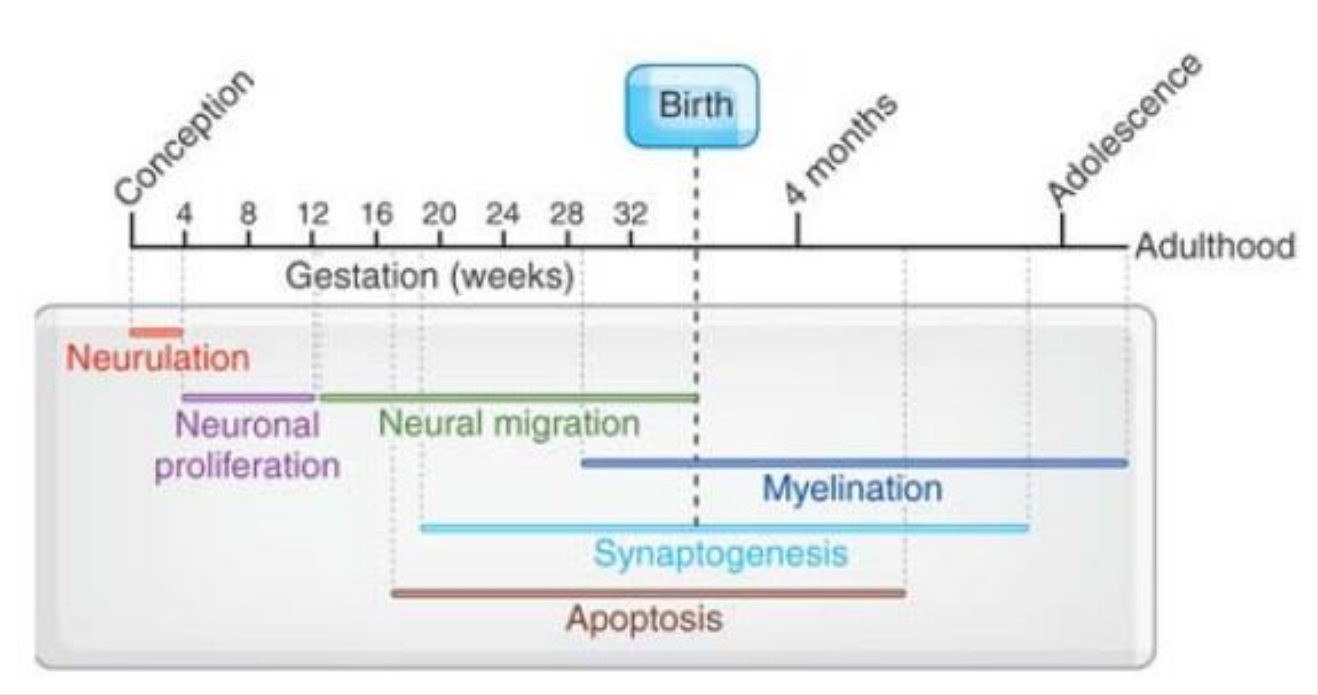
- Brain differentiates into cerebrum and cerebellum



Brain development

2nd trimester:

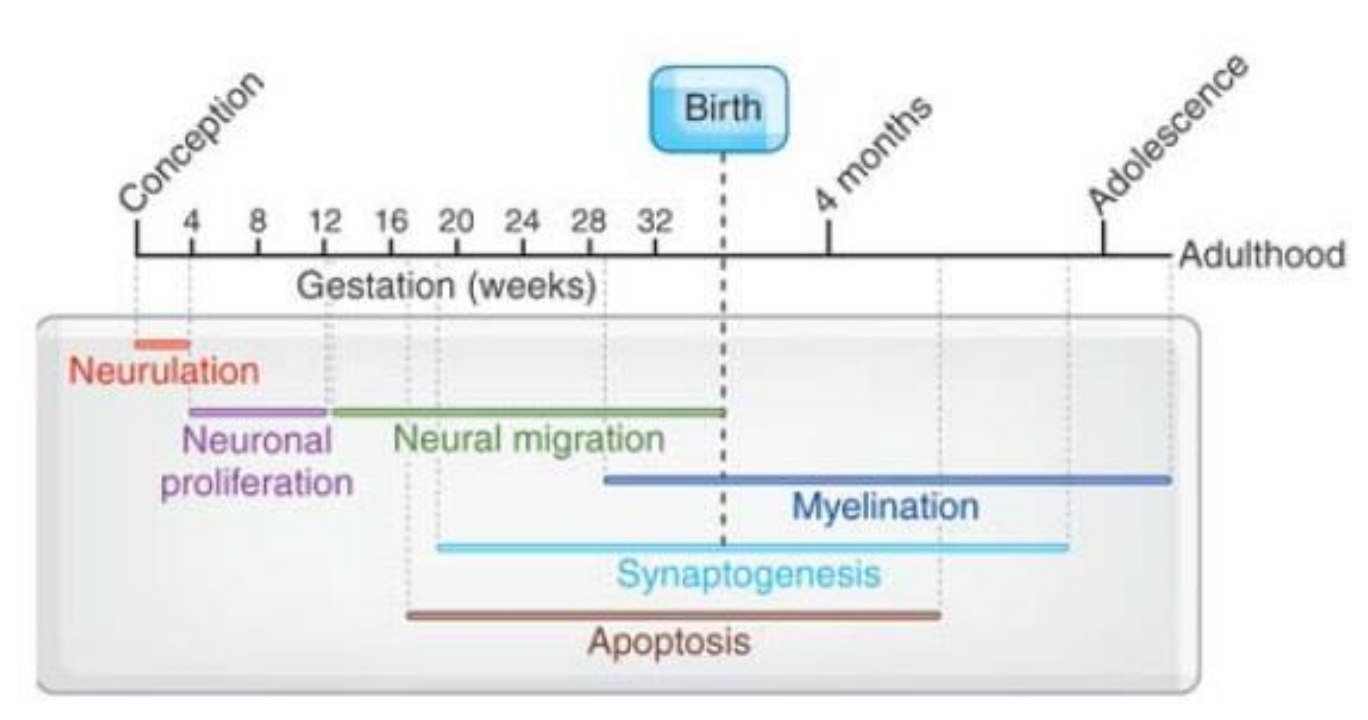
- Neurons migrate from periventricular regions to cortex



Brain development

3rd trimester:

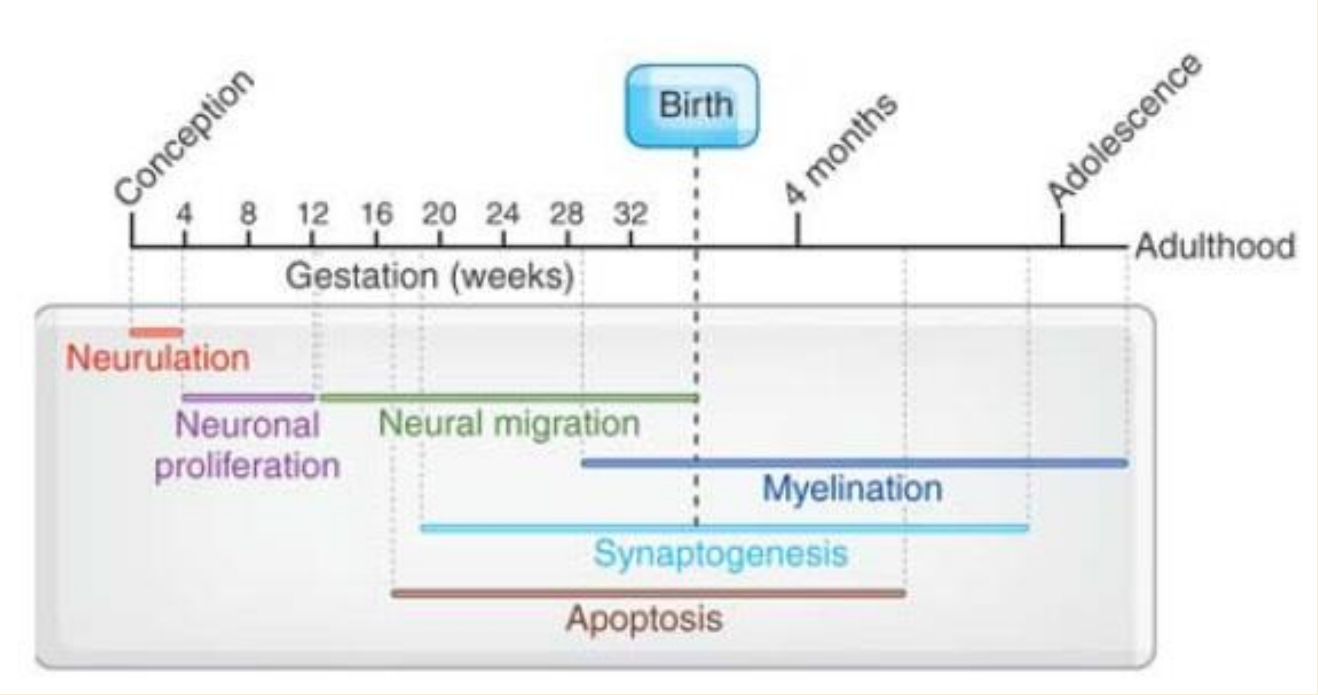
- Synapses are being formed and intensifies after birth
- Myelination starts and continues until adolescence



Brain development

10 years:

- Mature appearence on MRI



MRI findings

MRI Pattern	No. (%)
Malformation	32 (9.1)
White-matter damage of immaturity	149 (42.5)
Focal infarct	26 (7.4)
Cortical subcortical damage	33 (9.4)
Basal ganglia damage	45 (12.8)
Miscellaneous	25 (7.1)
Normal	41 (11.7)
Total	**351 (100)**

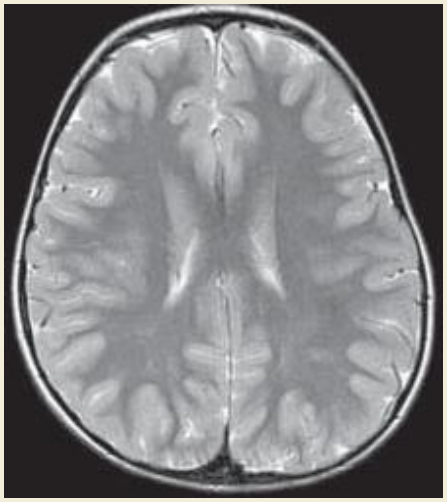
Bax et al, JAMA, October 4, 2006—Vol 296, No. 13

WMDI

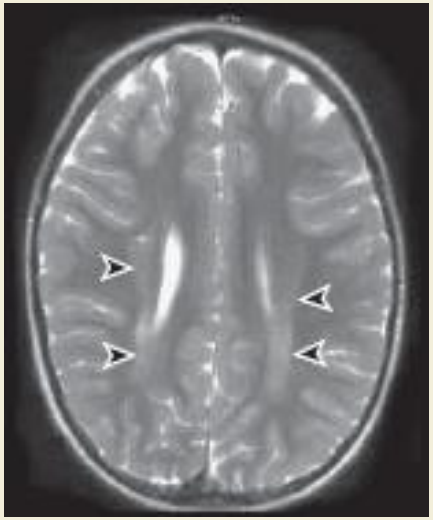
- White-matter damage of immaturity
- Includes PVL and periventricular hemorrhage
- Occurs before week 34
- Finding in
  - 70 % of diplegic
  - 35 % of hemi- and quadriplegic

WMDI

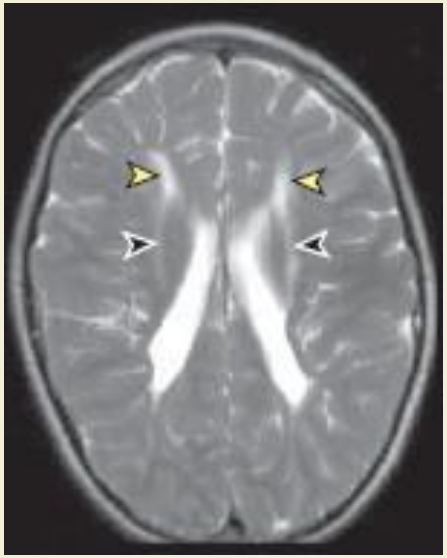
- Normal



- Diplegic

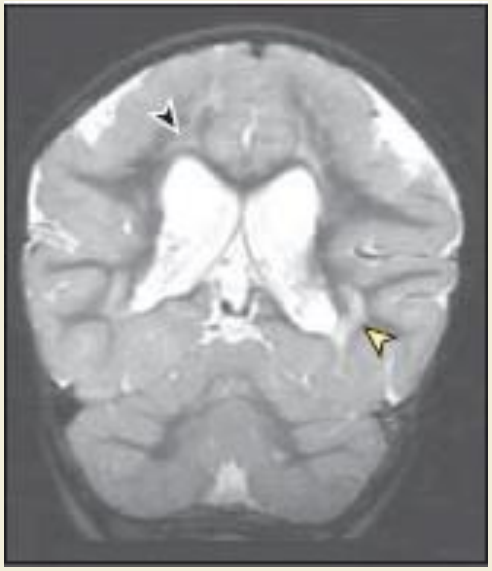


- Tetraplegic



Malformation

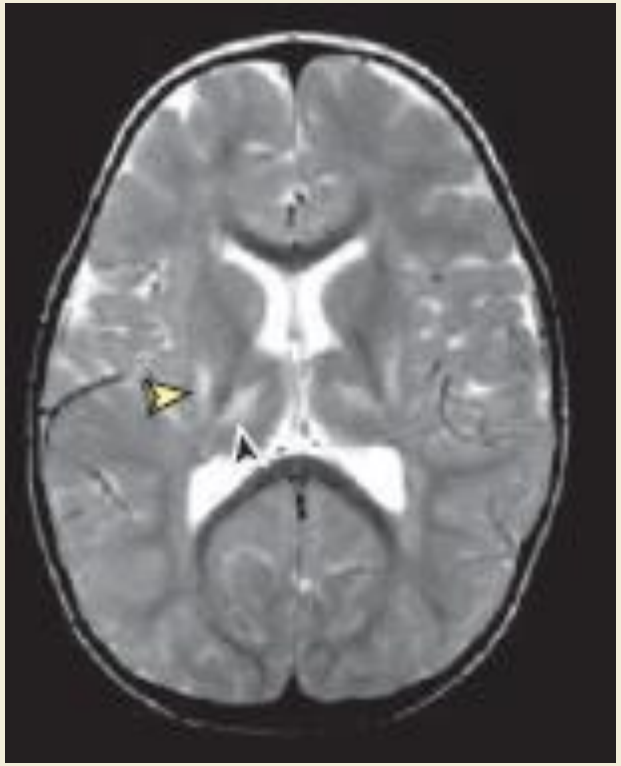
- Often 1 trimester
- Cortical dysplasia, lissencephaly, polymicrogyria, microencephaly
- Finding across all subtypes



Tetraplegic, extensive dysplasia of parietal lobes

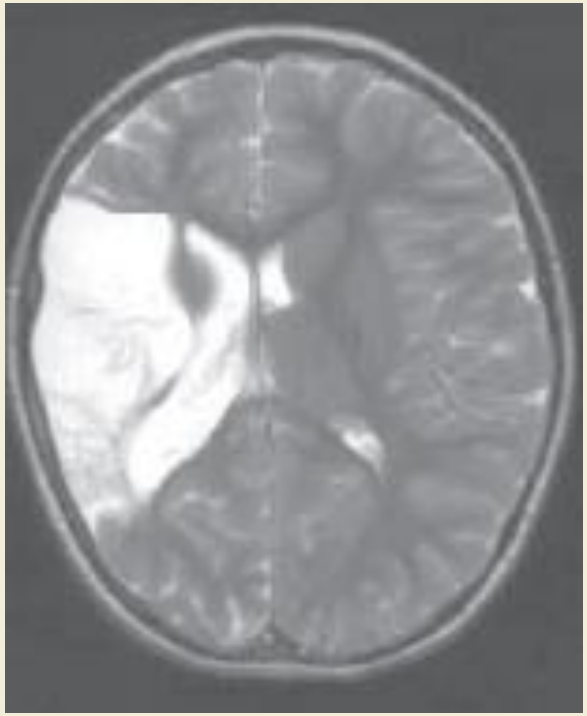
Basal Ganglia Damage

- Finding in 75% of dystonic patients



Focal Infacts

- Exclusively related to hemiplegia
- Finding in 30 % of hemiplegic patients



Infact in right middle cerebral artery

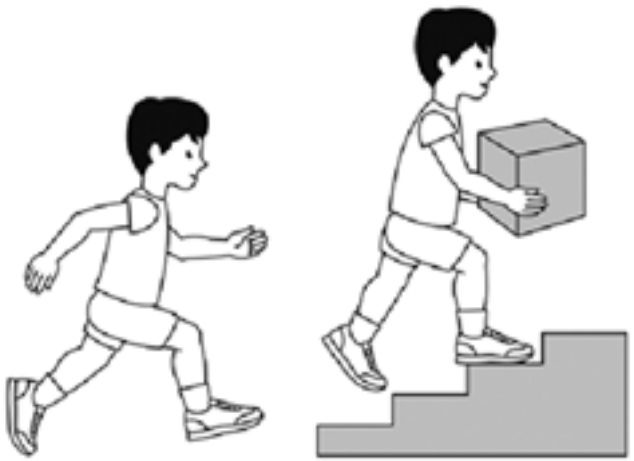
Functional Motor Abilities

Functional Motor Abilities

- Gross Motor Function Classification Score (GMFCS)
  - Five level ordinal grading system
  - Age groups (0-2,2-4,4-6,6-12,12-18)
  - High reliability
  - Prognostic value

Palisano et al. Dev Med Child Neurol 1997; 39: 214–23.

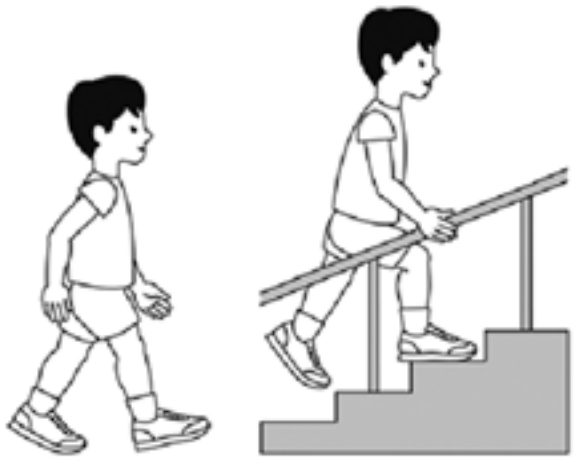
Level 1 (6-12 years)



GMFCS Level I

Children walk at home, school, outdoors and in the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance and coordination are limited

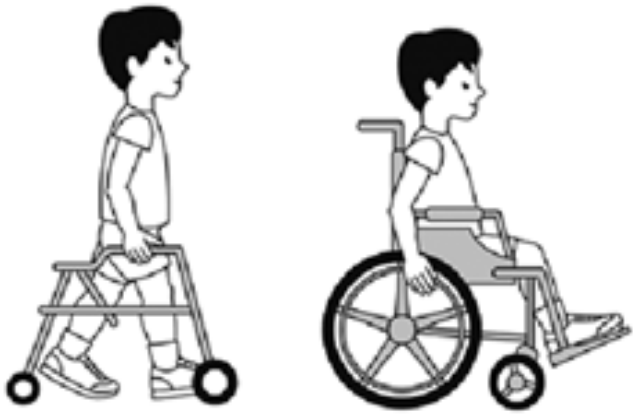
Level 2 (6-12 years)



GMFCS Level II

Children walk in most settings and climb stairs holding onto a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas or confined spaces. Children may walk with physical assistance, a hand-held mobility device or used wheeled mobility over long distances. Children have only minimal ability to perform gross motor skills such as running and jumping.

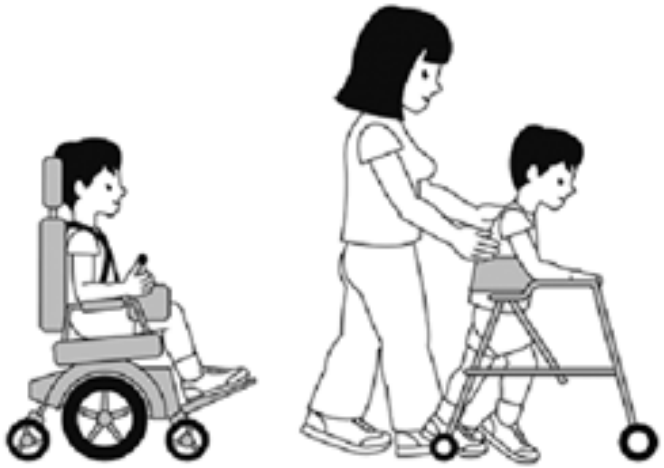
Level 3 (6-12 years)



GMFCS Level III

Children walk using a hand-held mobility device in most indoor settings. They may climb stairs holding onto a railing with supervision or assistance. Children use wheeled mobility when traveling long distances and may self-propel for shorter distances.

Level 4 (6-12 years)



GMFCS Level IV

Children use methods of mobility that require physical assistance or powered mobility in most settings. They may walk for short distances at home with physical assistance or use powered mobility or a body support walker when positioned. At school, outdoors and in the community children are transported in a manual wheelchair or use powered mobility.

Level 5 (6-12 years)

GMFCS Level V

Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements.

GMFCS reliability

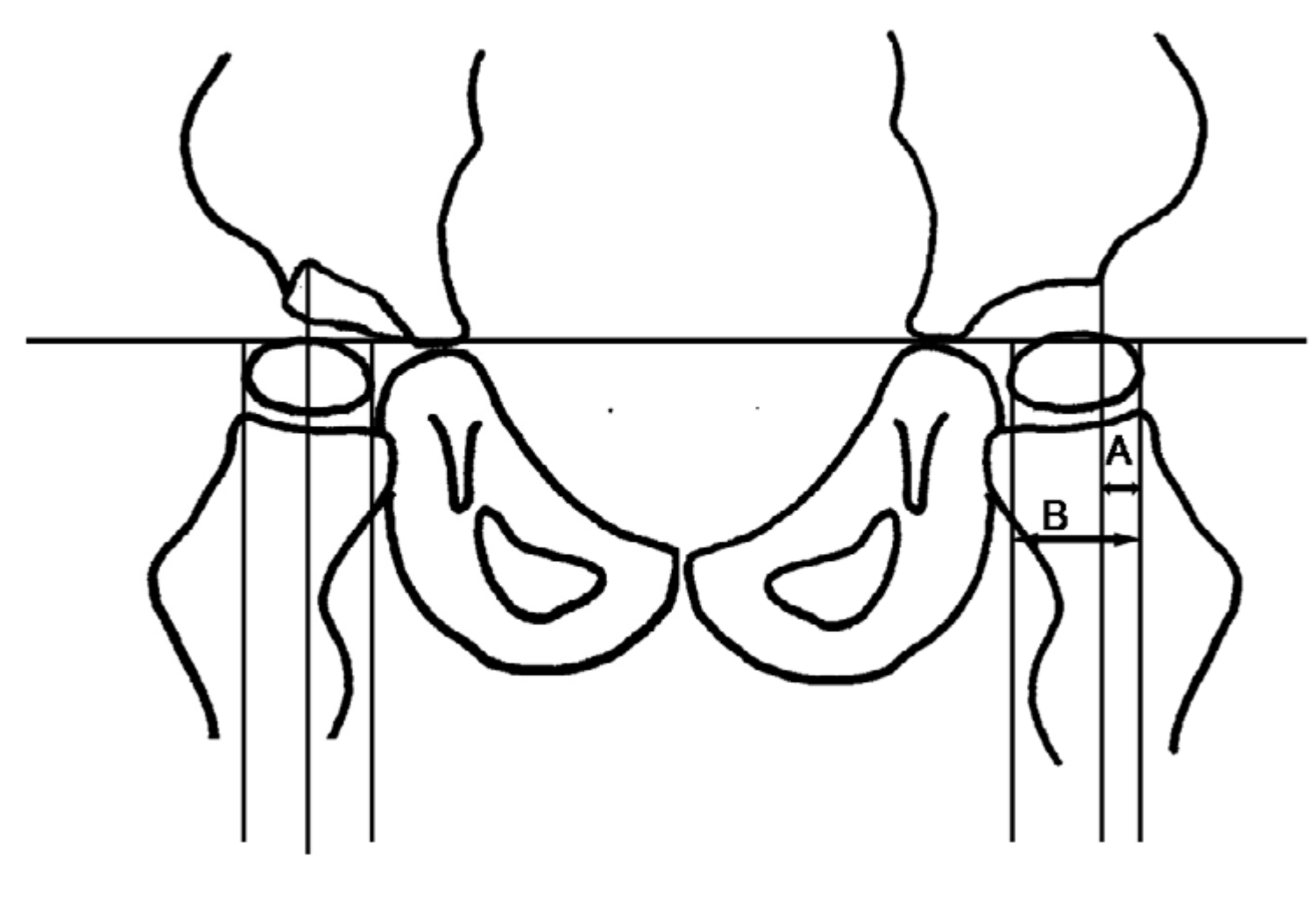
- High reliability
  - ICC 0.88 - 95
  - Kappa value 0.75 – 0.83

- Most children will remain at the same level from age 2

Sellier et al. Dev Med Child Neuro2012, 54: 815–821

Palisano et al. Dev Med Child Neurol 2008; 50: 744–50.

Prognostic value / Migration Index



Prognostic value GMFCS

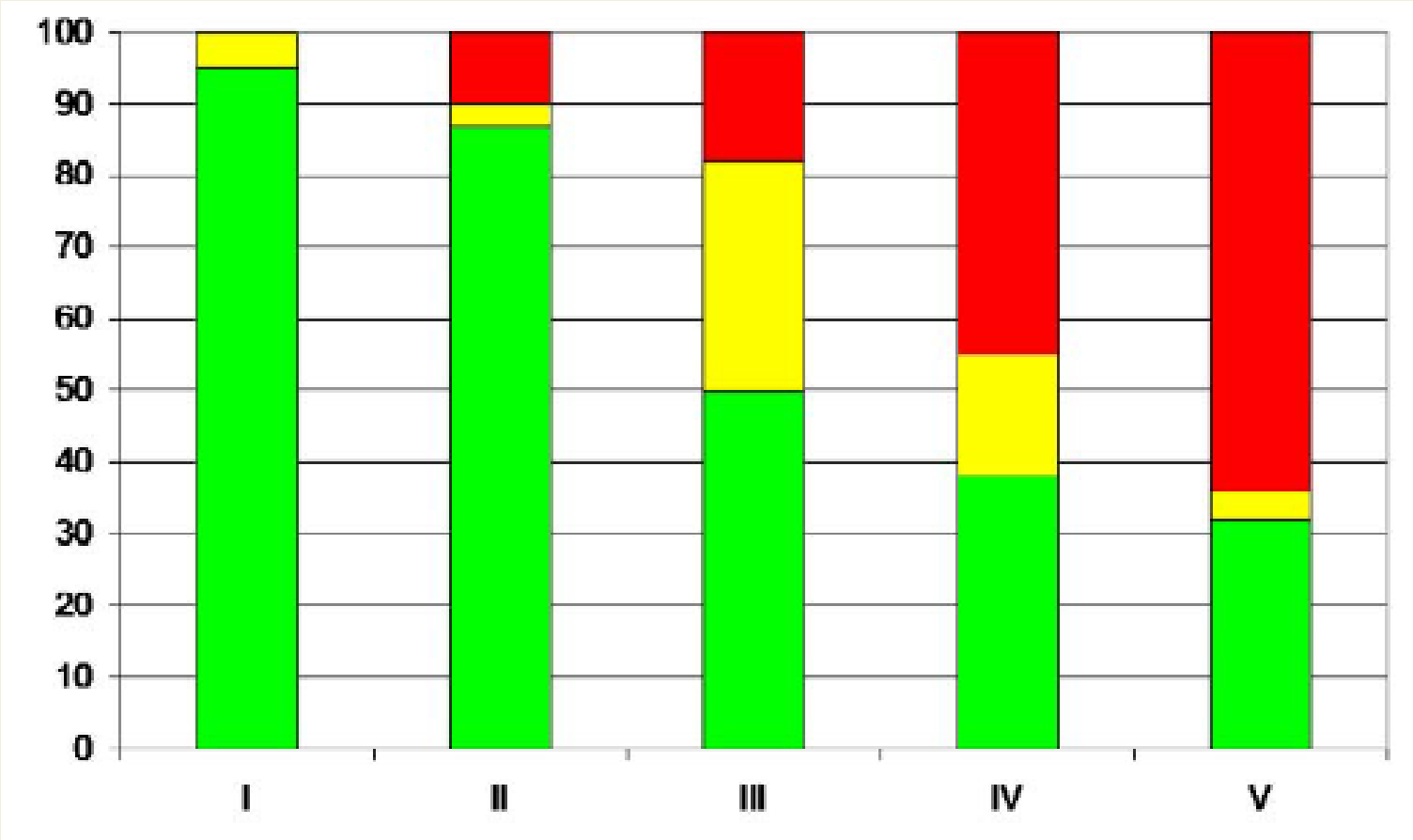
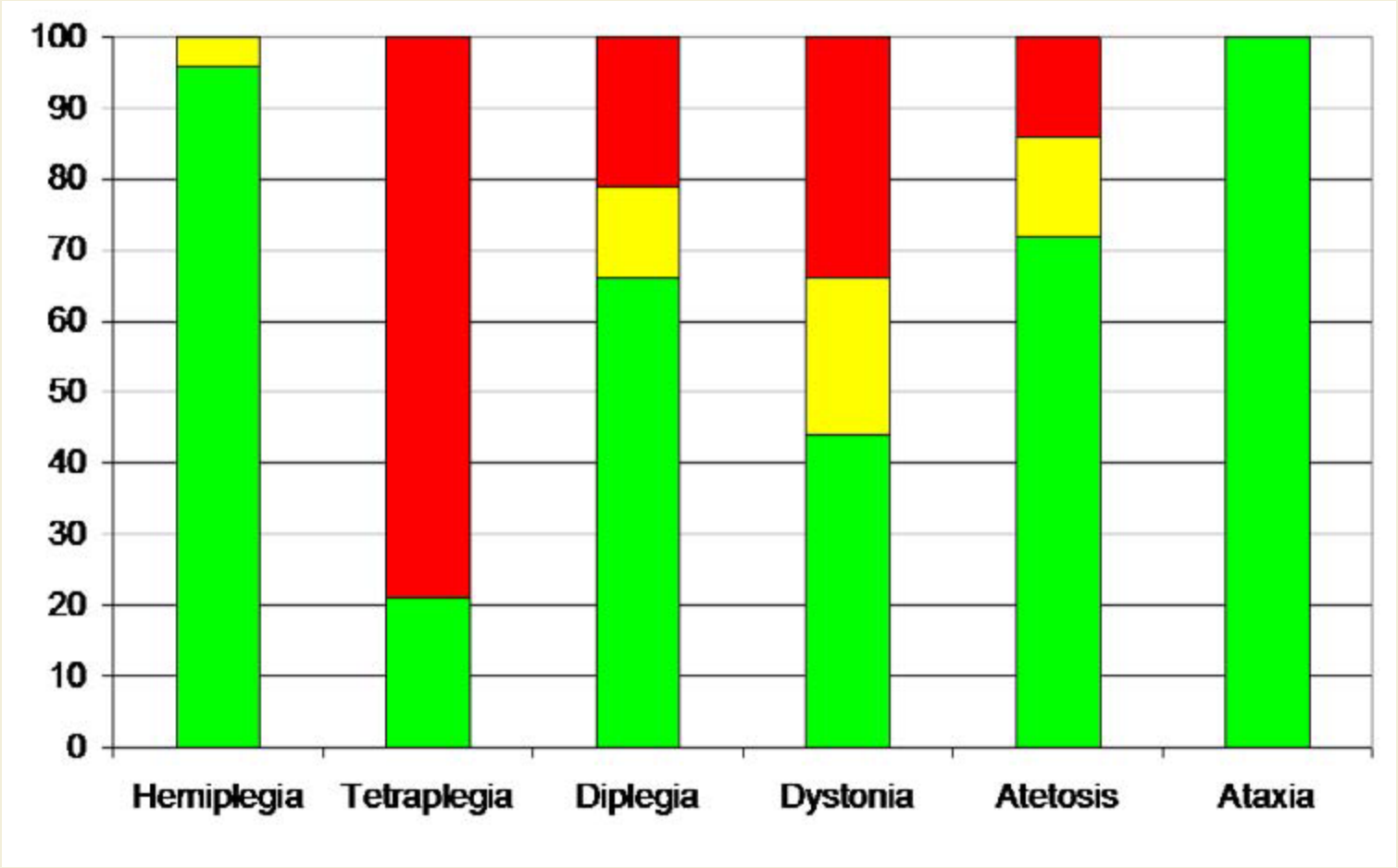


Figure 4
Proportion of children (%) with MP < 33% (green), 33–39% (yellow) and > 40% (red) in relation to GMFCS level.

Hagglund et al. BMC Musculoskeletal Disorders 2007, **8**:101

CP subtypes



Proportion of children (%) with MP < 33% (green), 33–39% (yellow) and > 40% (red) in relation to subdiagnosis.

Hagglund et al. BMC Musculoskeletal Disorders 2007, **8**:101

GMFCS usage

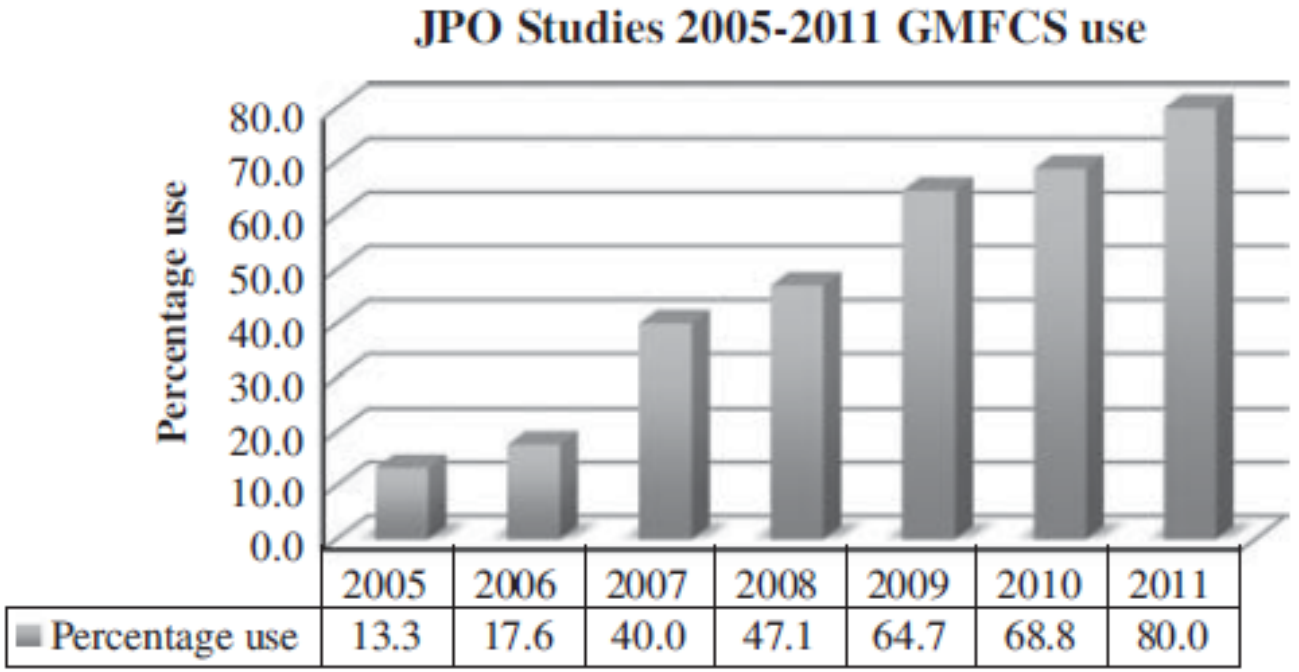


FIGURE 2. Yearly percentage use of Gross Motor Function Classification System (GMFCS) in published studies in *Journal of Pediatric Orthopaedics* (JPO), 2005 to 2011.

Mandaleson et al, J Pediatric Orthop 2014

Manual Ability Classification System (MACS)

Level I
Handles objects easily and successfully

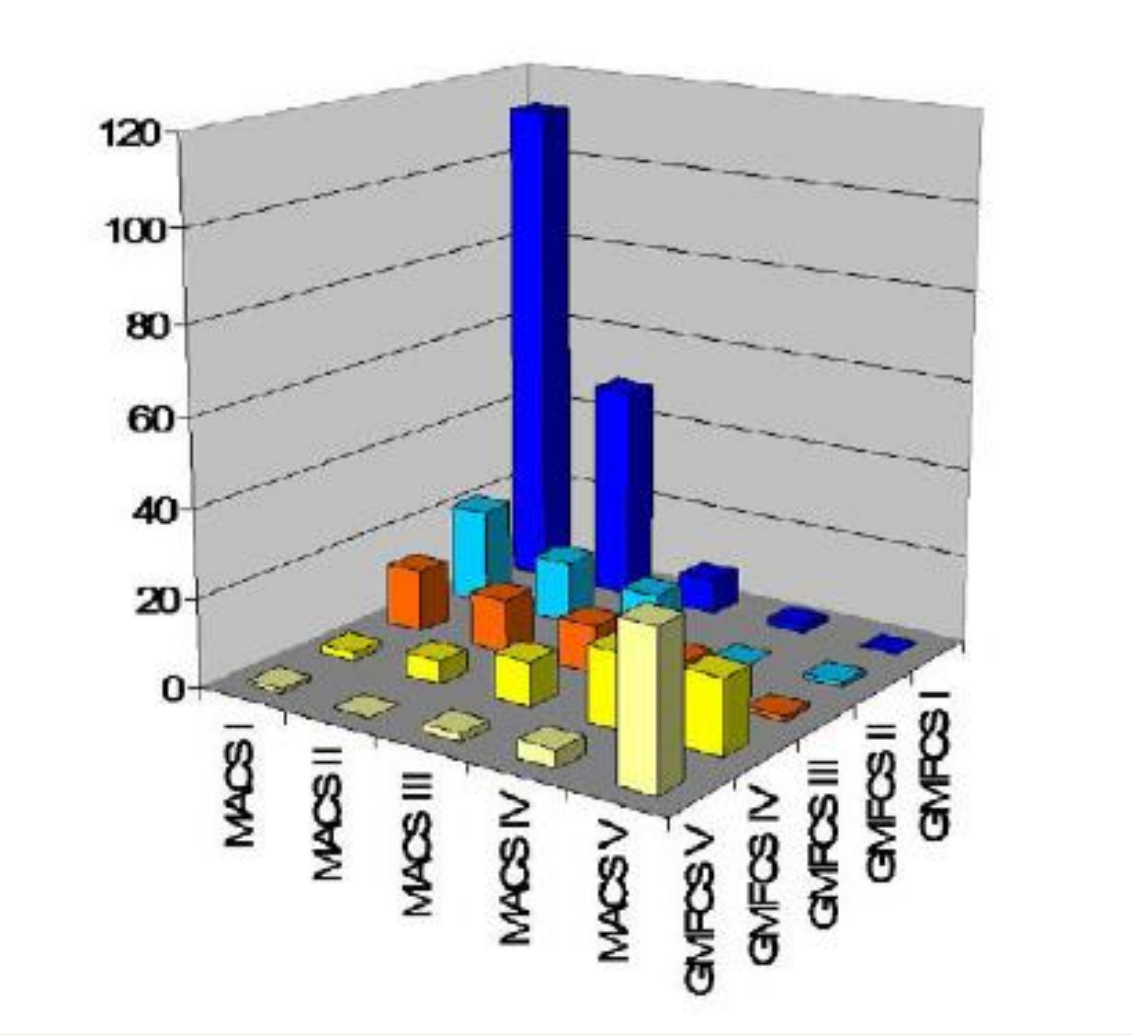
Level II
Handles most objects but with somewhat reduced quality and/or speed of achievement

Level III
Handles objects with difficulty; needs help to prepare and/or modify activities

Level IV
Handles a limited selection of easily managed objects in adapted situations

Level V
Does not handle objects and has very limited ability to perform even simple actions

Association GMFCS/MACS




i think with equality
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under the
law shall not

Paul Smith (1921 –2007)

American typewriter artist

Thank you!


New Year's Resolution:
Quit smoking
Get in shape
Don't waste money
Do not become a jazz singer in Venezuela
Liam was intent on making 2014 the year be kept his New Year's Resolution
wumo.com