MMed and DCH Lectures

Weekly by Zoom

Prof Trevor Duke

MMed and DCH Lectures

Neurological examination of children

October 12, 2020

Prof Trevor Duke

Neurological examination of children

- “The neurological examination of children is the same as for adults”
  - Conscious level
  - Peripheral nervous system
    - Tone
    - Power
    - Coordination
    - Reflexes
    - Sensation
  - Cranial nerves

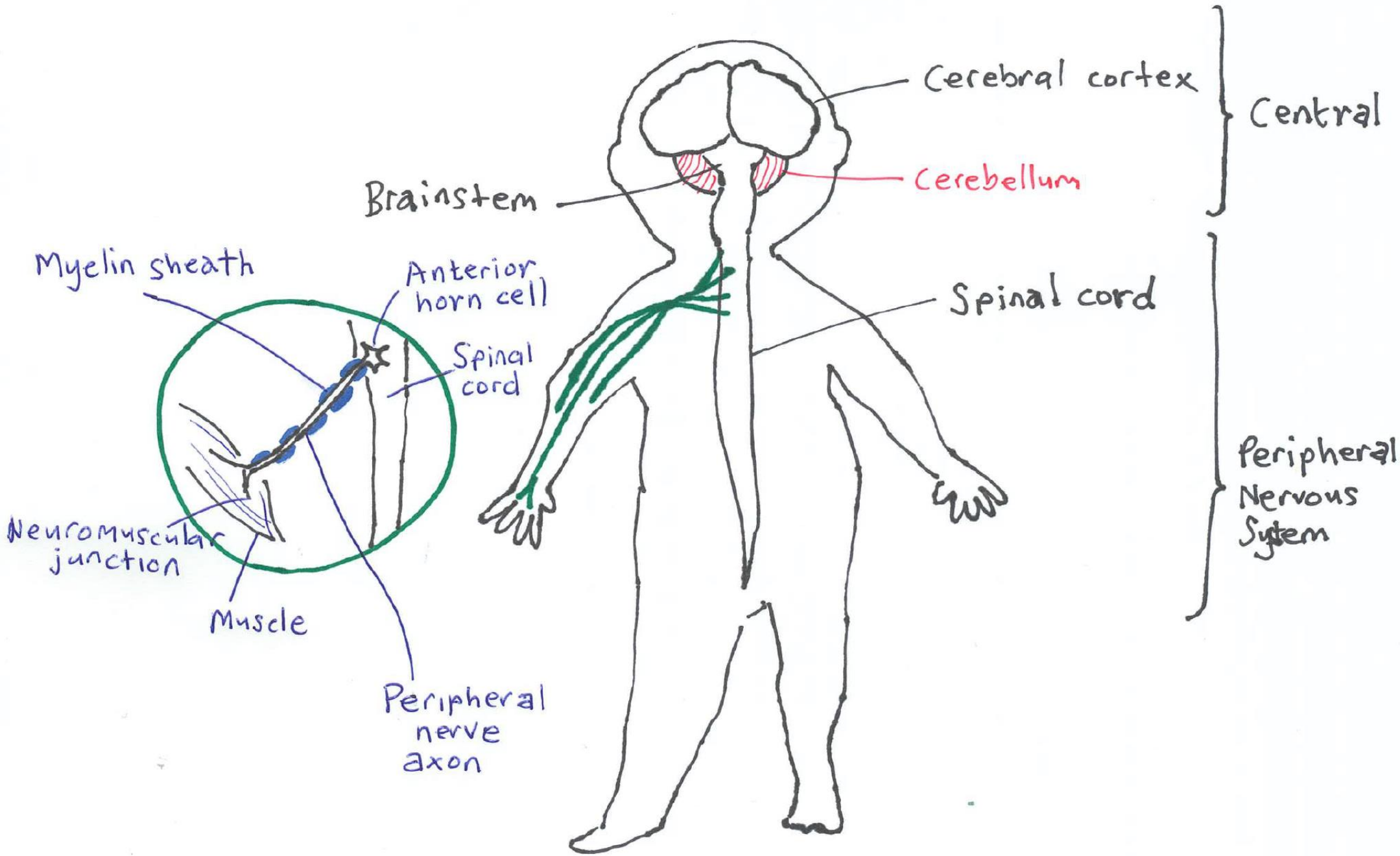
Neurological examination of children

- “The neurological examination of most children is *different* to adults”
  - Tailored to the presenting problem and symptoms
  - Opportunistic
  - Observation of function, activity, behavior, movement, interaction
  - Integrated with the general examination – many neurological symptoms have non-neurological causes (e.g. weakness and hypokalaemia)
  - Takes into account age and developmental stage

2 questions

1. *Where* is the problem?
   I. Central (brain)?
      - Brain cortex
      - Cerebellum
   II. Peripheral
      - Spinal cord
      - Anterior horn cell
      - Peripheral nerve
      - Neuromuscular junction
      - Muscle
   III. Unilateral or bilateral?

2. *What* is the problem?


Cerebral cortex
Cerebellum
Brainstem
Spinal cord
Central
Peripheral Nervous System
Myelin sheath
Anterior horn cell
Spinal cord
Neuromuscular junction
Muscle
Peripheral nerve axon

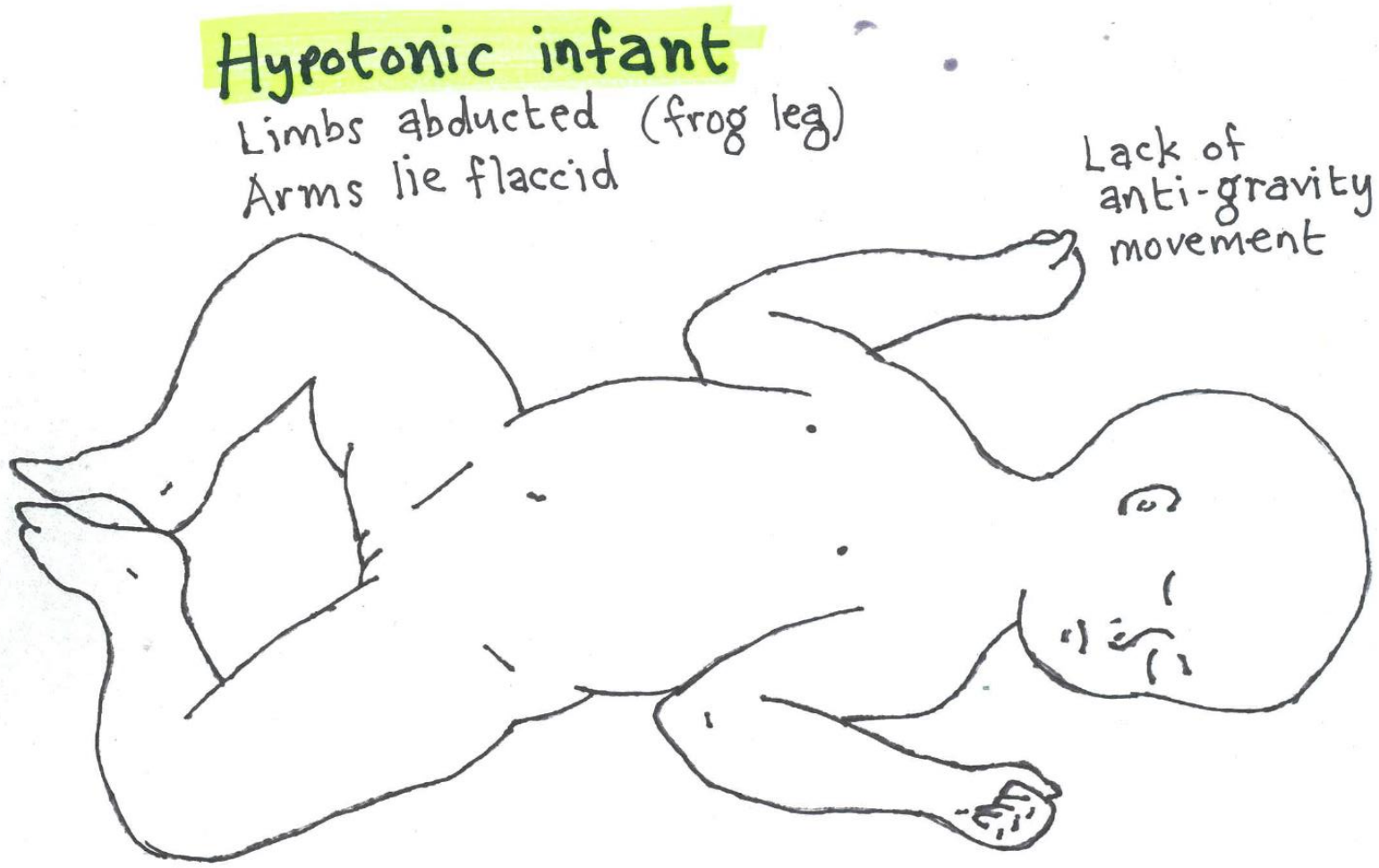
Where is the lesion?	Conscious level, higher functions	Tone	Power	Reflexes	Coordination / fine motor movement	Sensory function	Examples of diagnoses
Cerebral cortex	Impaired - Dysphasia Visual neglect	↑↑↑	↓	↑↑	Usually poor Sometimes dystonia or spasticity	Normal / impaired, often un-assessable	Stroke Bleeding Congenital anomaly Tumour Tuberculoma
Cerebellum	Impaired, dysarthria	↑↑	↓	↑↑	Impaired, intention tremor	Normal	Tumour Tuberculoma
Brain stem	Impaired conscious state	↑↑	↓	↑↑	Limited by motor weakness, often impaired	Normal to impaired	Ischaemia stroke Tumour Tuberculoma
Spinal cord	Normal	↑↑ or ↓↓	↓ below the level of the lesion	↑ or ↓	Limited by motor weakness below the level of the lesion	↓↓ or absent below the level of the lesion	Trauma Abscess Potts disease Transverse myelitis Tumour
Anterior horn cell	Normal	↓↓	↓↓	↓↓	Limited by motor weakness	Normal	Polio SMA
Peripheral nerve	Normal	↓	↓↓	↓↓	Limited by motor weakness	↓↓↓	Guillain Barre
Neuromuscular junction	Normal	↓ (botulism, SMA) or ↑↑↑ (tetanus)	↓↓	Botulism ↓↓ Tetanus ↑↑	Limited by motor weakness	Normal	Botulism Tetanus
Muscle	Normal	↓ (sometimes hypertrophy)	↓↓ may be proximal or distal, truncal or limb or both	↓ (with disuse) or normal early	Normal	Normal	Myopathy Muscular dystrophy

Symptom based paediatric neurology

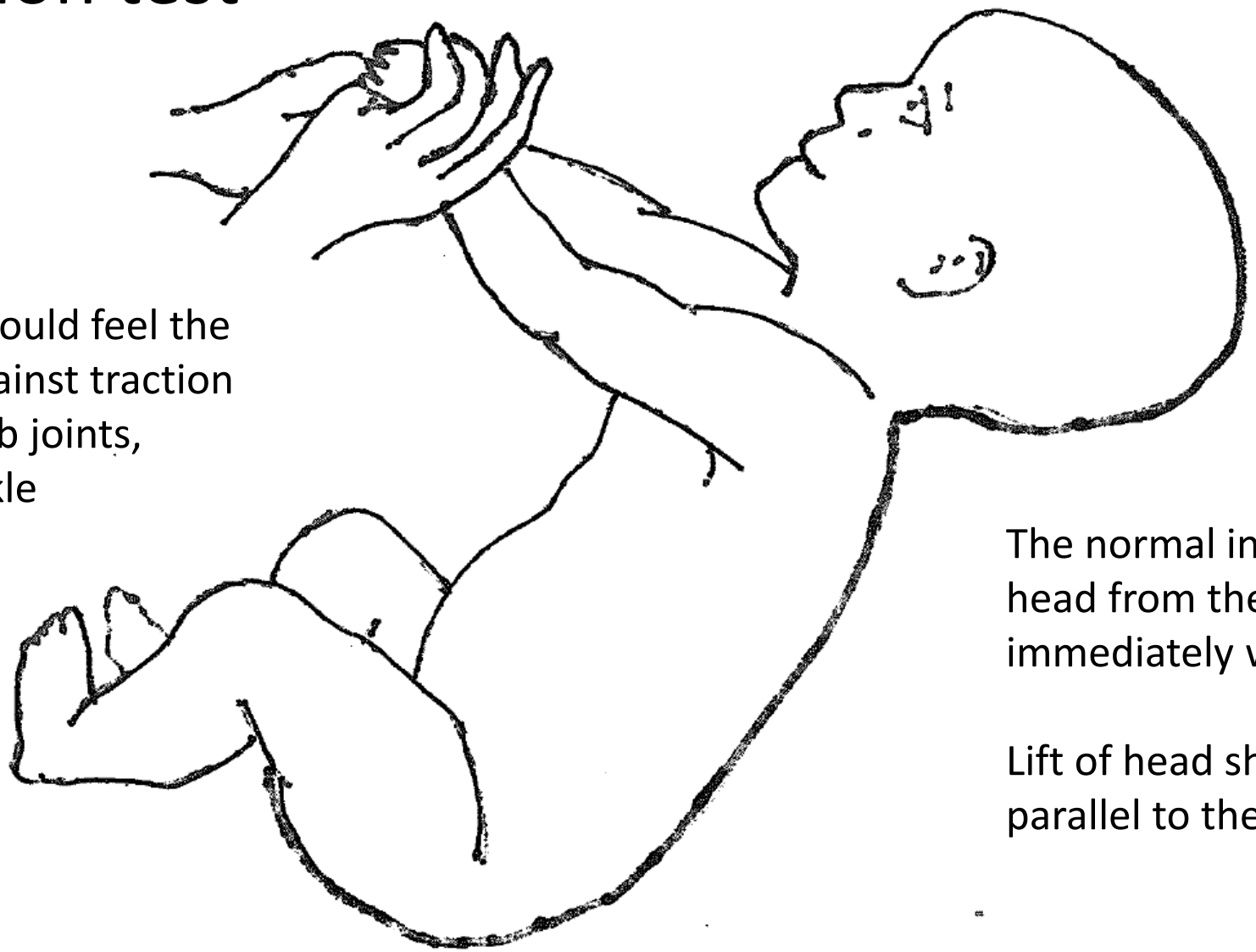
- The hypotonic infant
- New onset of difficulty walking
- Hemiplegia
- The child with delayed walking
- Movement disorders - choreoathetosis

The hypotonic infant

- Assess level of alertness
- Assess posture
- Traction test
- Vertical suspension
- Horizontal suspension



The traction test



The examiner should feel the infant pulling against traction
Flexion of all limb joints, elbow, knee, ankle

The normal infant lifts the head from the flat surface immediately with the body

Lift of head should be parallel to the lift of the body

Clues to central hypotonia

- Altered conscious state
- Fisting of hands
- Scissoring of legs on vertical suspension
- Tendon reflexes ↑↑
- Abnormalities of other organs

Clues to peripheral hypotonia

- ↓ Tendon reflexes
- Muscle atrophy
- Fasciculation
- Conscious state normal
- No abnormalities of other organs

Infantile botulism

- *Clostridium botulinum* toxin blocks acetylcholine release at neuromuscular junction. 2 weeks to 6 months of age
  - Hypotonia and failure to thrive
  - Severe progressive paralysis
  - SIDS
  - Live in dusty environments – soil disruption (agriculture, construction)
  - Constipation, poor feeding
  - Ptosis, weak cry, dilated pupils with poor light reaction
- Treatment
  - Respiratory support, feeding
  - Self limiting (2-6 weeks+)
  - Do not use aminoglycosides

Other conditions causing hypotonia in infants

- Spinal cord injury
  - Birth trauma (breech delivery – traction on spinal cord)
- Down syndrome
- Spinal muscular atrophy
- Prader Willi syndrome
  - Severe hypotonia
  - Delayed motor milestone
  - Absent tendon reflexes
  - Cryptorchidism (undescended testes)
  - Onset of insatiable hunger and obesity
- Congenital metabolic defects

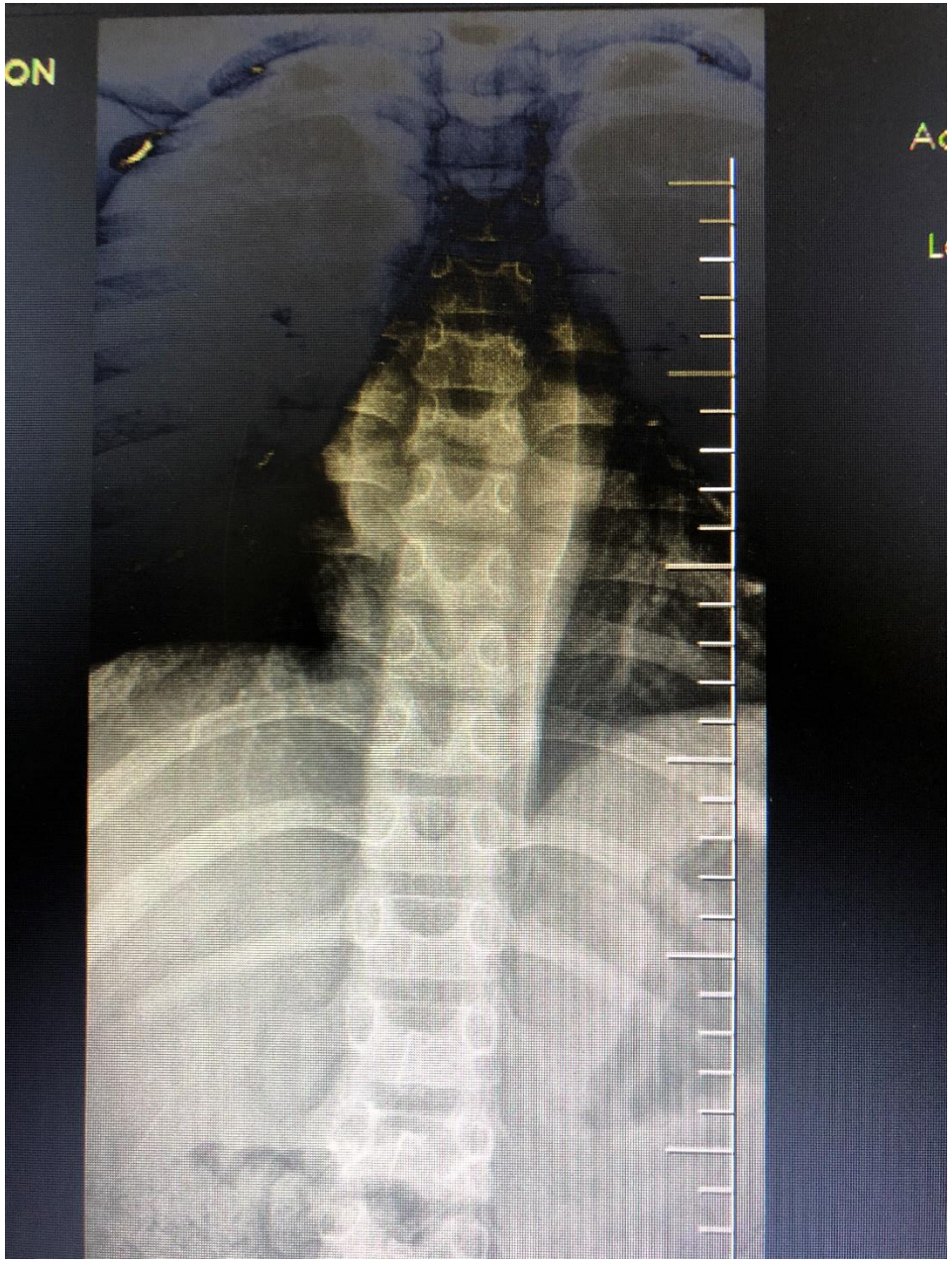
New onset of difficulty walking

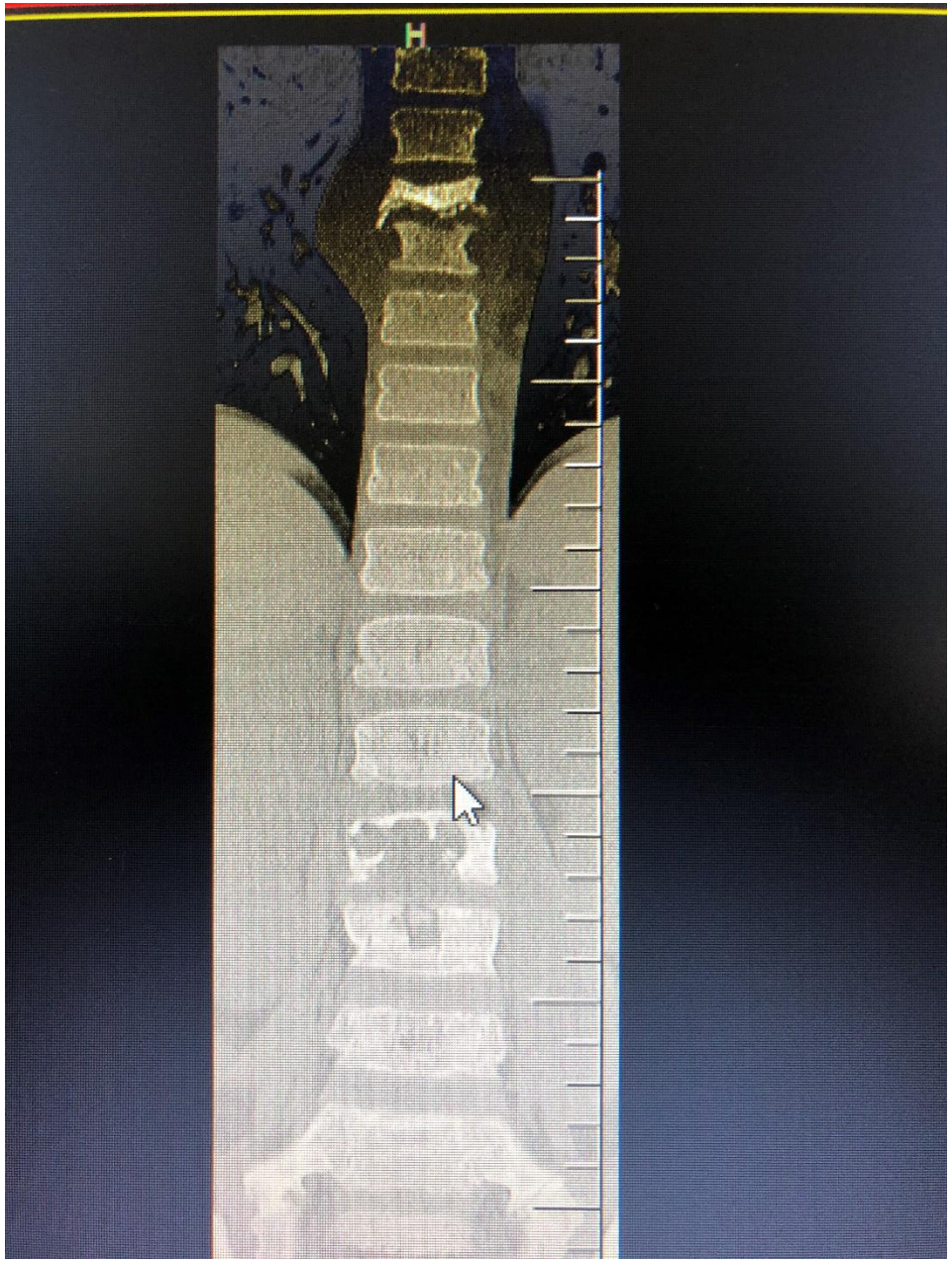
- 12 year old boy, progressive weakness of lower limbs over 2 days, back pain. Now can only walk with assistance.
- On examination
  - Conscious state normal
  - Upper limbs strong, normal sensation
  - Lower limbs
    - Tone increased
    - Power – cannot elevate legs against resistance, weak anti-gravity movement
    - Reflexes – knee jerks increased
    - Sensation – altered sensation thighs, lower legs and feet
    - Coordination – cannot do heel- skin test, upper limbs normal
  - Palpable tender bladder

New onset of difficulty walking

- Where is the lesion?
- What is the lesion?

ON


ON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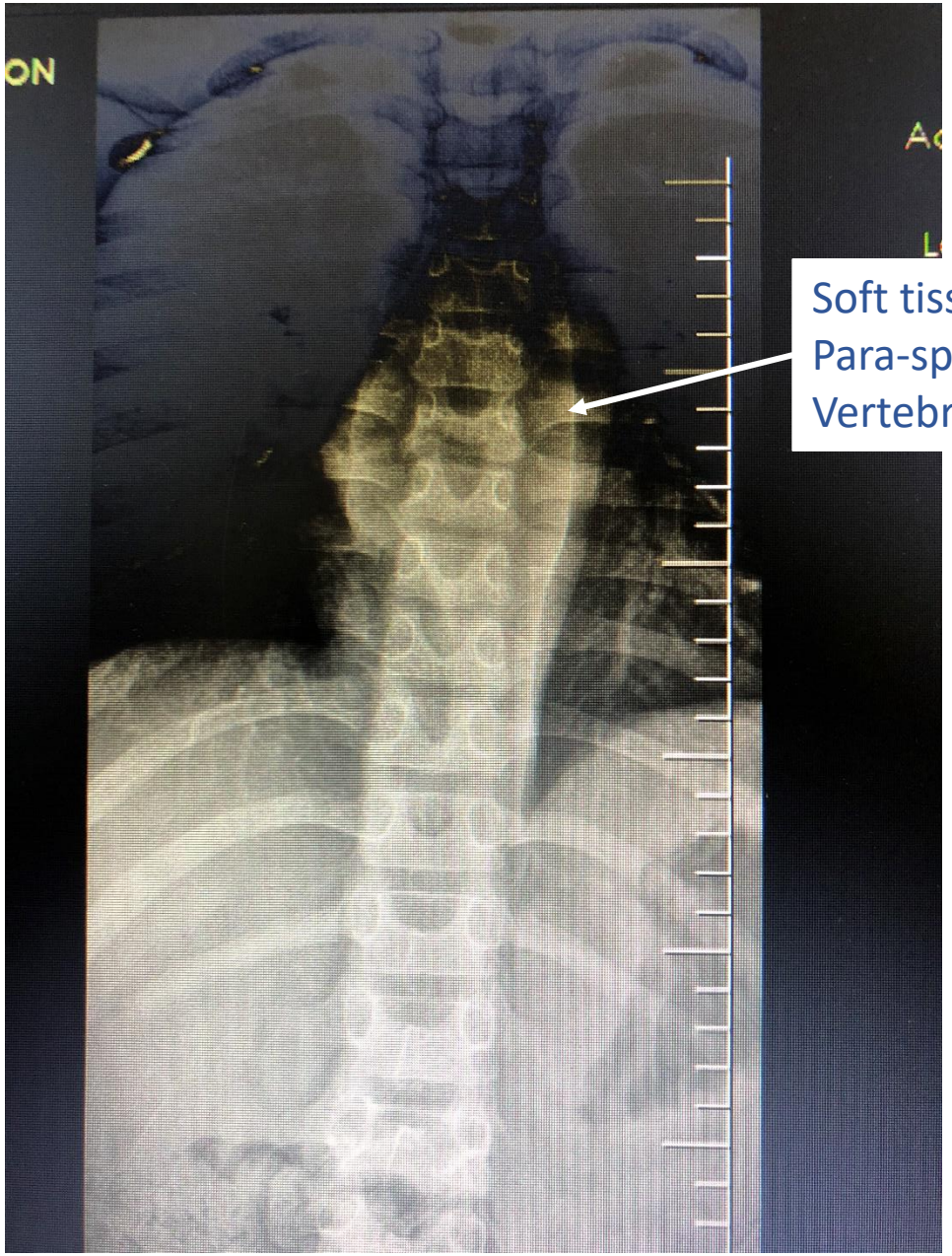
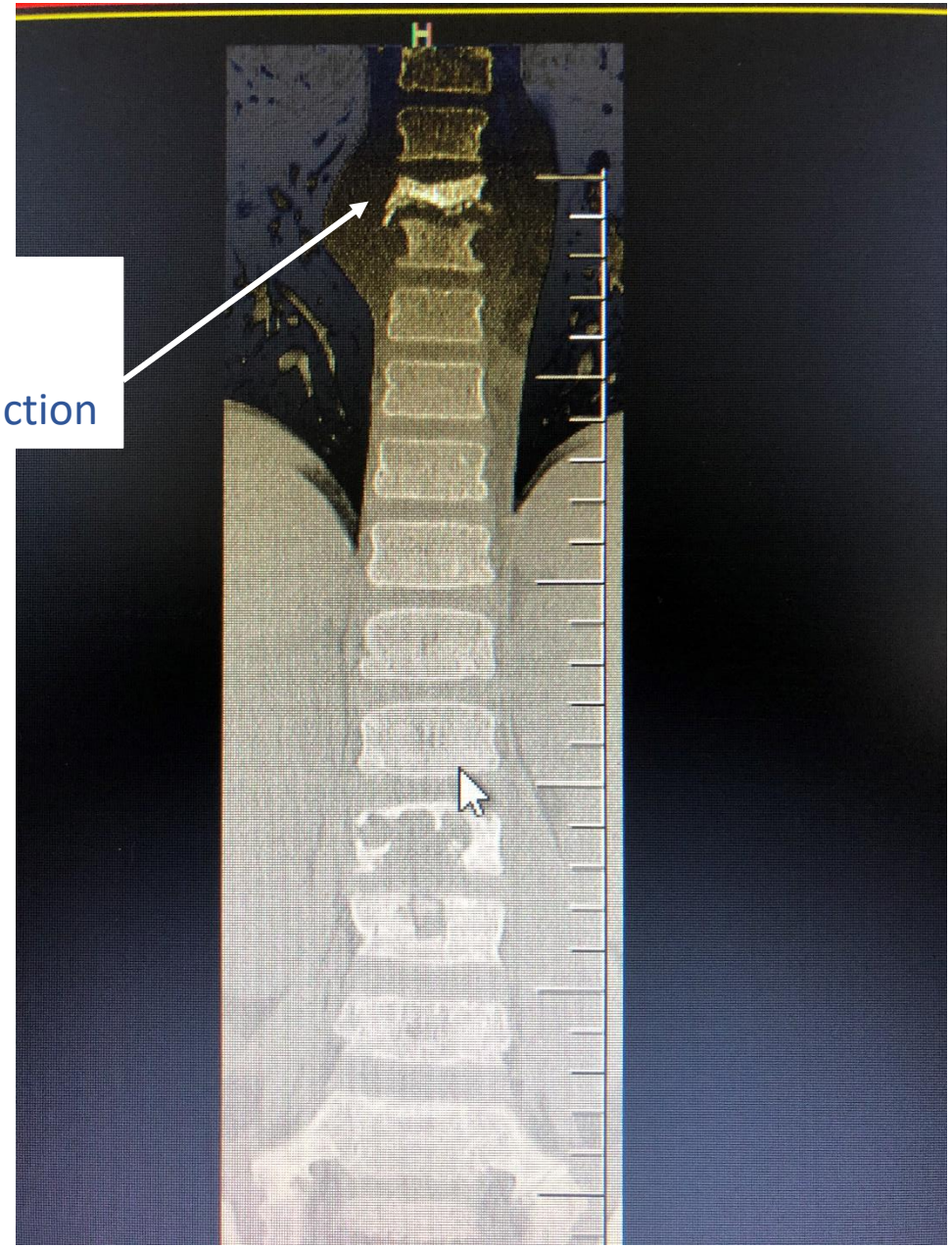


Soft tissue swelling
Para-spinal abscess
Vertebral body destruction



Spinal lesions

Where is the lesion?	**Conscious level, higher functions**	**Tone**	**Power**	**Reflexes**	**Coordination / fine motor movement**	**Sensory function**	**Examples of diagnoses**
Spinal cord	Normal	↑↑ or ↓↓	↓ below the level of the lesion	↑ or ↓	Limited by motor weakness below the level of the lesion	↓↓ or absent below the level of the lesion	Trauma Abscess Potts disease Transverse myelitis Tumour

Hemiplegia

- Where is the problem?
- Cortical on the contralateral side

Hemiplegia – Where is the problem?

One side of body weak or immobile, hypertonic or floppy, hyperreflexia up-going plantar reflex
Other higher functions (e.g. speech impaired), visual neglect

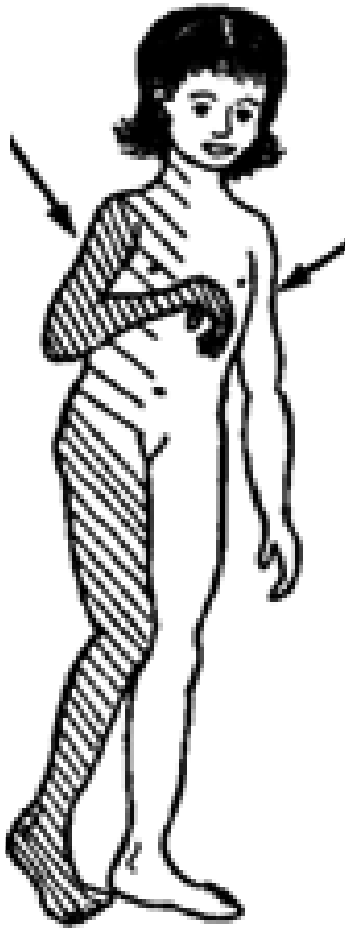
One side of body normal, or near normal

Hemiplegia

- Is it acute sudden onset or slowly progressive?
- Acute
  - Stroke, trauma
  - Haemorrhage
  - Hemiplegic migraine / hemiplegic epilepsy
  - Congenital heart disease and cerebral embolus
  - Rheumatic heart disease with cerebral embolus
  - Infection – meningitis, abscess
  - Vasculitis – e.g. SLE
  - Cancer – L-asparaginase, methotrexate
  - Venous sinus thrombosis
- Chronic slowly progressive hemiplegia – brain tumor, tuberculoma

Hemiplegia – clinical clues to the cause of stroke

One side of body weak or immobile, hypertonic or floppy, hyperreflexia up-going plantar reflex
Other higher functions (e.g. speech impaired), visual neglect

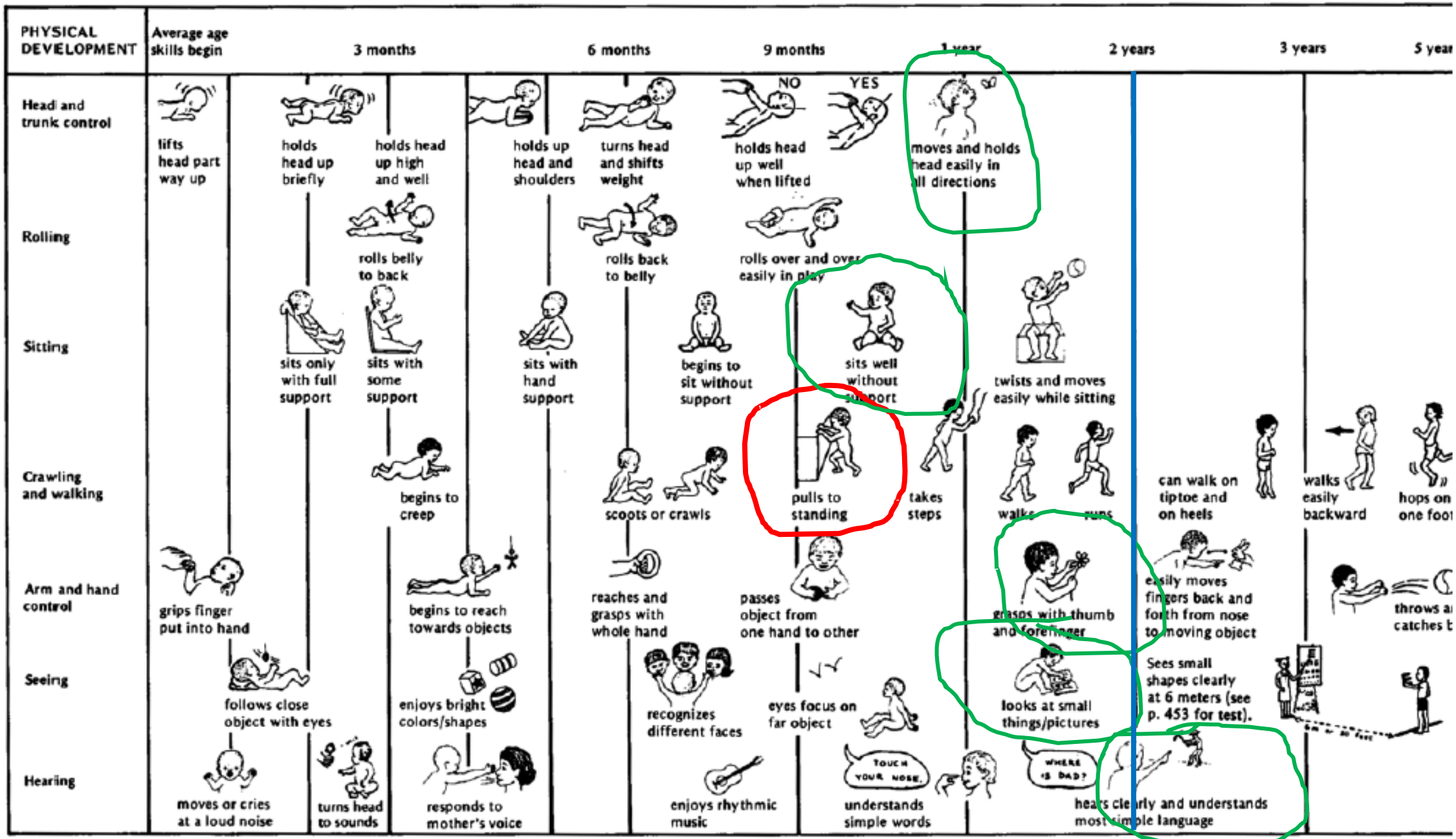


One side of body normal, or near normal

- Fever, other signs of infection – abscess, meningitis, tuberculosis
- Heart murmur, cardiomegaly – evidence of CHD or RHD
- Rash – vasculitis, RHD
- Raised intracranial pressure – haemorrhage, tuberculosis, tumour
- Recurrent - hemiplegic migraine
- History of cancer treatment

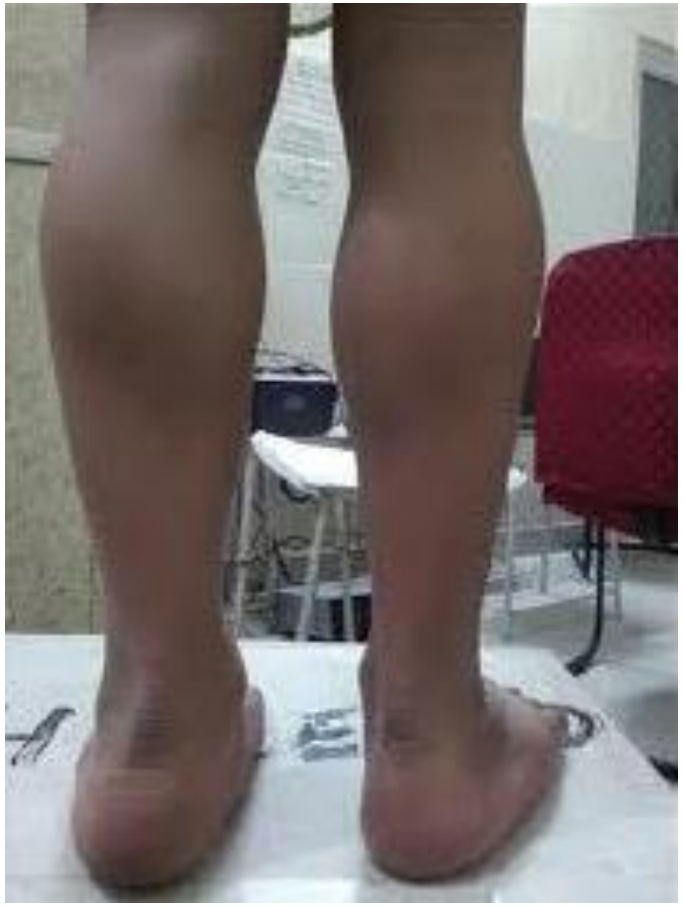
Child with delayed walking

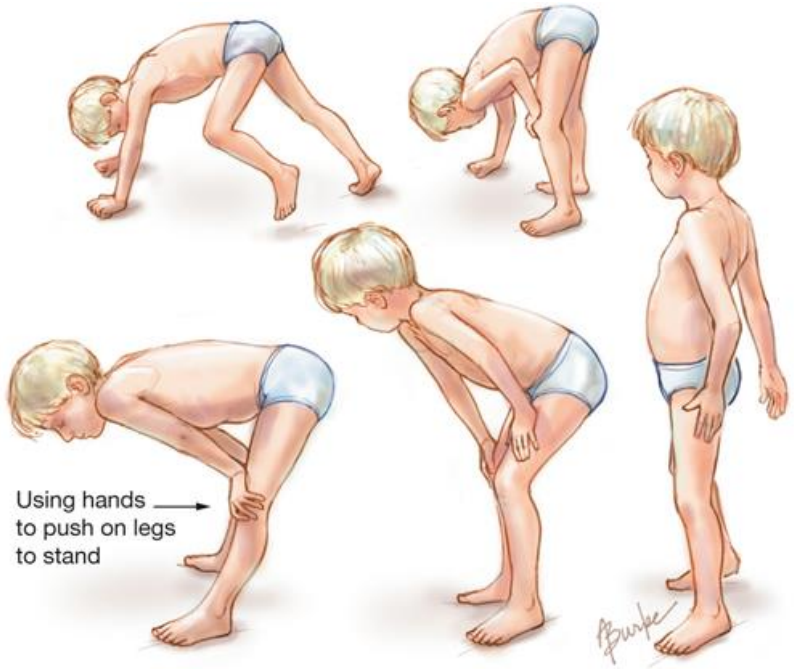
- 2 ½ year old boy, still does not walk
- Can sit without support from 1 year
- Pulls to standing
- Alert, plays with toys, says many words and short sentences
- Responds to sounds, understands simple language


PHYSICAL DEVELOPMENT
Average age skills begin
3 months
6 months
9 months
1 year
2 years
3 years
5 year
Head and trunk control
Rolling
Sitting
Crawling and walking
Arm and hand control
Seeing
Hearing
lifts head part way up
holds head up briefly
holds head up high and well
holds up head and shoulders
turns head and shifts weight
NO
YES
holds head up well when lifted
moves and holds head easily in all directions
rolls belly to back
rolls back to belly
rolls over and over easily in play
sits only with full support
sits with some support
sits with hand support
begins to sit without support
sits well without support
twists and moves easily while sitting
begins to creep
scoots or crawls
pulls to standing
takes steps
walks
runs
can walk on tiptoe and on heels
walks easily backward
hops on one foot
grips finger put into hand
begins to reach towards objects
reaches and grasps with whole hand
passes object from one hand to other
grasps with thumb and forefinger
easily moves fingers back and forth from nose to moving object
throws and catches b
follows close object with eyes
enjoys bright colors/shapes
recognizes different faces
eyes focus on far object
looks at small things/pictures
Sees small shapes clearly at 6 meters (see p. 453 for test).
moves or cries at a loud noise
turns head to sounds
responds to mother's voice
enjoys rhythmic music
TOUCH YOUR NOSE.
understands simple words
WHERE IS DAD?
hears clearly and understands most simple language

On examination

- Conscious state normal
- Tone normal / hypotonic
- Power in proximal muscles poor
- Coordination normal
- Sensation normal
- Mild scoliosis
- Thick calves





Child with delayed walking

- Where is the problem?
  - Cerebral cortex
  - Cerebellum
  - Brain stem
  - Spinal cord
  - Anterior horn cell
  - Peripheral nerve
  - Neuromuscular junction
  - Muscle

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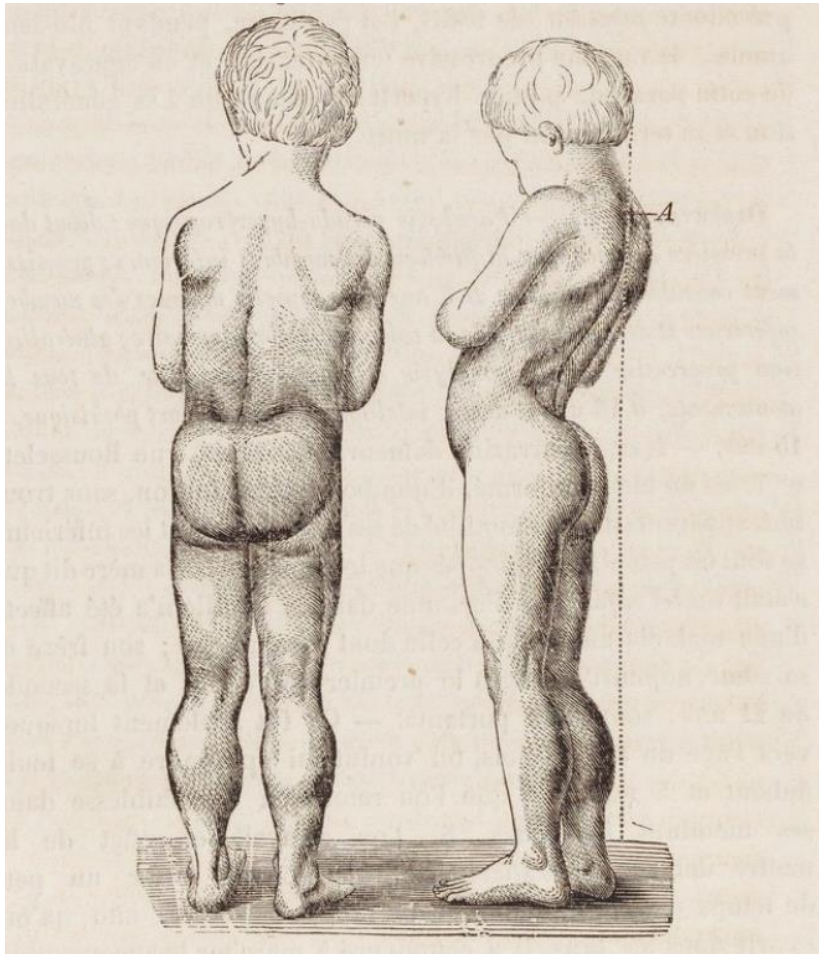
Muscle	Normal	↓ (sometimes hypertrophy)	↓↓ may be proximal or distal, truncal or limb or both	Normal or ↓↓ with disuse	Normal	Normal	Myopathy Muscular dystrophy

Muscular dystrophy

- X-linked, boys
- Delayed walking, toe walking, Gower's sign
- Weak proximal muscles (thigh, shoulder girdle)
- Calf hypertrophy (thick muscles, mostly fat, not strong)
- By 15 years wheelchair bound with scoliosis and marked lordosis (c-curvature of spine)
- Restrictive lung disease, pulmonary hypertension
- Steroids
- Physiotherapy
- Mobilisation



Muscular dystrophy in PNG

- Some forms not as severe
- Differentiate from spinal muscular atrophy, no hypertrophy, lack of reflexes
- Variable natural history, compared with Duchenne MD

Neurological examination of children

1. Where is the problem?
2. What is the problem?