Introduction
Classification
Management

CEREBRAL PALSY

Dr. Farjad Afzal
Physical therapist

DEFINITION

- A group of disorders of the development of movement and posture, causing activity limitations
- Non progressive disturbances that occurred in the developing fetal or infant brain
- Cerebral palsy is a permanent disorder of movement and posture caused by lesion in immature brain during fetal or infancy resulting sensory and motor deficit along with mental retardation, speech impairment and hearing problems (P. Rosenbaum et al, 2006)

MAJOR CRITERIA

- A **neuromotor control deficit** that alters movement or posture
- a **static brain lesion**
- acquisition of the **brain injury either before birth or in the firs years of life**

ETIOLOGY

- Exact cause of cerebral palsy is not clear, the brain damage can occur during pregnancy, at the time of birth or after the birth.
- 80% children with cerebral palsy show **structural problem in white matter** in their brain (Yarnell, 2013).
- Typical causes during the intrauterine life are exposure to radiation, infections, **hypoxia and birth trauma**.
- Other causes that can lead to cerebral palsy are **immaturity**, head injury after birth, genetic factor, maternal infection, periventricular leukomalacia, cerebral dysgenesis, intracranial bleeding and asphyxia (2013).
- Principal cause of death in these is related to circulatory and respiratory problem (Durufle-Tapin et al., 2014)

CAUSES:

- Prenatal (70%)
  Infection, anoxia, toxic, vascular, Rh disease, genetic, congenital malformation of brain
- Natal (5-10%)
  Anoxia, traumatic delivery, metabolic
- Post natal
  Trauma, infection, toxic

PRENATAL PERIOD

where in most causes of CP occur.

- Intrauterine stroke
- Genetic malformations

The most common currently understood causes are related to brain injury occurring in children born prematurely.

POSTNATAL CEREBRAL INJURY AND CP

- Major causes:
  - CNS infections
  - Vascular causes
  - Head injury
- Other Causes:
  - Anoxia
  - Ischemia
  - Inflammation

Brain injury

- Types of brain damage
  - Bleeding
  - Brain malformation
  - Trauma to brain
  - Lack of oxygen
  - Infection
  - Toxins
  - Unknown

RISK FACTORS

- Most common risk factors for cerebral palsy are early delivery and pregnancy disorders (Placental abruption, chorioamnionitis, prolonged rupture of membranes, intrauterine growth restriction, pre-eclampsia, multiple births, placenta previa, bleeding, cervical conization, and congenital malformation) (Tronnes et al., 2014).
- home delivery and infections during pregnancy are important risk factors (Bangash et al., 2014).

POSSIBLE INDICATORS OF CEREBRAL PALSY

- **After two months:**
  1. poor head control
  2. stiffness in the legs that cross or scissors when picked-up
  3. pushing away, arching pack
  4. failure to smile by 3 months

- **After six months:**
  1. Continued difficulty controlling head when picked up
  2. Floppy or limp posture.
  3. Feeding difficulties - persistent gagging or choking

POSSIBLE INDICATORS OF CEREBRAL PALSY

- **After 10 months:**
  1. Crawl by pushing off with one hand and leg while dragging opposite hand and leg.
  2. Inability to sit unsupported
- **After 12 months:**
  1. Inability to crawl.
  2. Inability to stand without support.
- **After 24 months:**
  1. Inability to walk.
  2. Inability to push toys with wheels.

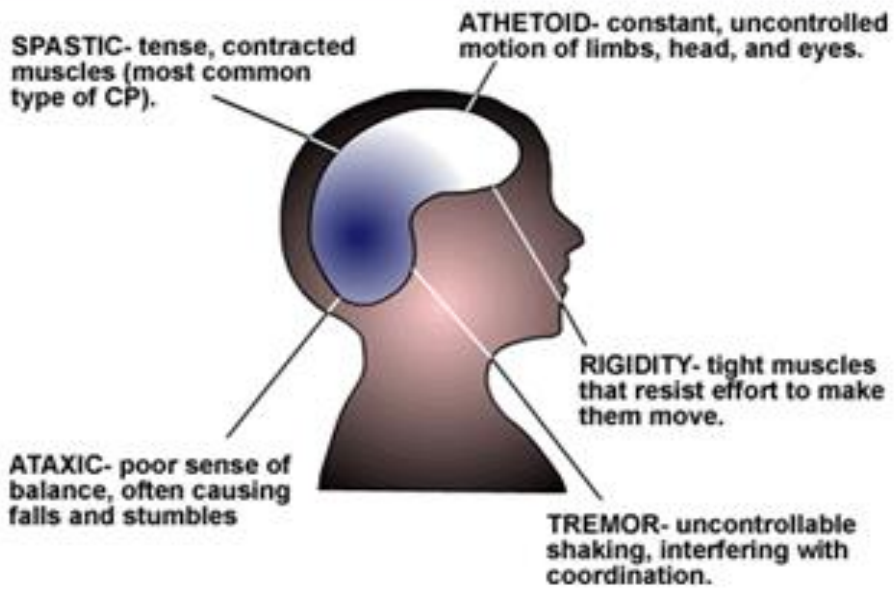
CLASSIFICATION

- According to American Academy of Cerebral Palsy there is variety of cerebral palsy, a motor classified into spastic, athetoid, tremor, rigidity, ataxic, atonic and mixed(Minear, 1956).

CLASSIFICATIONS:

Cerebral Palsy: Physiologic

- Athetoid
- Ataxic
- Rigid-Spastic
- Atonic
- Mixed



PYRAMIDAL V/S EXTRA PYRAMIDAL

Pyramidal lesion= spastic
Extrapyramidal= athetoid , ataxic, dystonia, hypotonic

Pyramidal
Lesion is usually in the motor cortex, internal capsule and/or cortical spinal tracts.
Extrapyramidal
Lesion is usually in the basal ganglia, Thalamus, Sub thalamic nucleus and/or cerebellum.

PYRAMIDAL V/S EXTRA PYRAMIDAL

Comparison of Symptoms		
	Pyramidal	**Extrapyramidal**
Tone	increased	alternating
Type of tone	spastic	rigid
DTR's	increased	normal to increased
Clonus	Present	occ. present
Contractures	early	late
Primitive Reflexes	delayed	persistent
Involuntary movements	rare	frequent

CLASSIFICATION

- Spastic
- Dyskinetic,
- Hypotonic
- Ataxic
- Mixed forms

SPASTIC

- Spastic cerebral palsy is most common type of cerebral palsy, in which muscles are stiff and spasticity is striking feature and is due to deficiency of GABA in spinal cord (Albright, 1995)

  75% of children with CP
  Associated with UMN syndrome findings
  - Increased muscle stretch reflexes
  - Babinski response
  - Weakness
  - Difficulty with coordination.

  Can be associated with extensor or flexor posturing (decerebrate and decorticate posturing)

POSTURING

DECORTICATE
(Flexor)

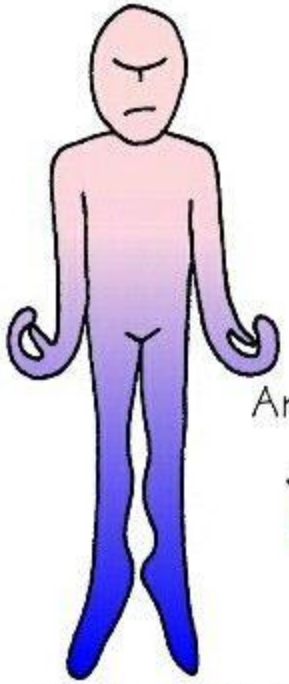
Arms are like "C s"

Moves in toward the "Cord"

Problems With Cervical Spinal Tract or Cerebral Hemisphere.

C.J. MILLER

DECEREBRATE
(Extensor)



Arms are like "e s"

Problems Within Midbrain or Pons.

MANAGEMENT OF SPASTICITY

- Botulinum toxin
- Baclofen
- Selective dorsal rhizotomy

Botulinum toxin

- protein products of the *Clostridium botulinum bacterium*
- taken up by endocytosis at the cholinergic nerve terminals blocking release of synaptic vesicles
- effectively blocks the action of the synapse at the neuromuscular junction for several months until a new neuromuscular junction is established
- Used to reduce spasticity in selective muscle and learn movement patterns
- Improve gate in children with hemiplegic and diplegic spastic children

Baclofen

- inhibit the GABA-B receptors in the spinal cord
- blocking the excitatory effect of sensory input
- Oral doses of baclofen can have side-effects, including drowsiness, which can outweigh its benefits.
- Intrathecal baclofen (ITB) is increasing in popularity as it is thought to be more effective

Selective dorsal rhizotomy

Selective dorsal rhizotomy is a neurosurgical technique to divide the posterior nerve rootlets in the lumbosacral region to reduce the level of spasticity, in particular in muscle groups of the lower limb.

ATHETOID

- athetoid also named dyskinetic cerebral palsy results from extra pyramidal damage (basal ganglia) and characterized by involuntary movements such as torsion spasm, dystonia, chorea and athethosis (Mei Hou, 2006)
- associated with bilirubin encephalopathy and hypoxic brain injury (Mei Hou, 2006).
- Slow involuntary movements of hands, arms and face, involuntary facial grimaces and drooling, difficulty in sitting and straight walking, difficulty in holding objects are striking features of athetoid cerebral palsy (Brainspinalcord.org)

ATHETOID cont…

- A dyskinetic tone abnormality
- With alternating tone or cocontraction in the antagonist and agonist muscle groups
- Causing varied abnormal postures and often fluctuating tone.
- Other dyskinetic forms:
  1. Athethosis
  2. Choreiform
  3. Choreoathethoid
- Athetosis- slow writhing, wormlike
- Chorea- quick, jerky movements
- Choreoathetosis- mixed
- Hypotonia- floppy, low muscle tone, little movement

ATAXIC

- In ataxic cerebral palsy there is a problem in coordination and damage is in cerebellum.
- It account for 5% to 10% and least frequent form of cerebral palsy (McHale, 2000)
  - Rare
  - Must be differentiated from degenerative processes of the cerebellum.
  - Results from damage to the cerebellum
  - Ataxia- tremor & drunken- like gait

HYPOTONIC

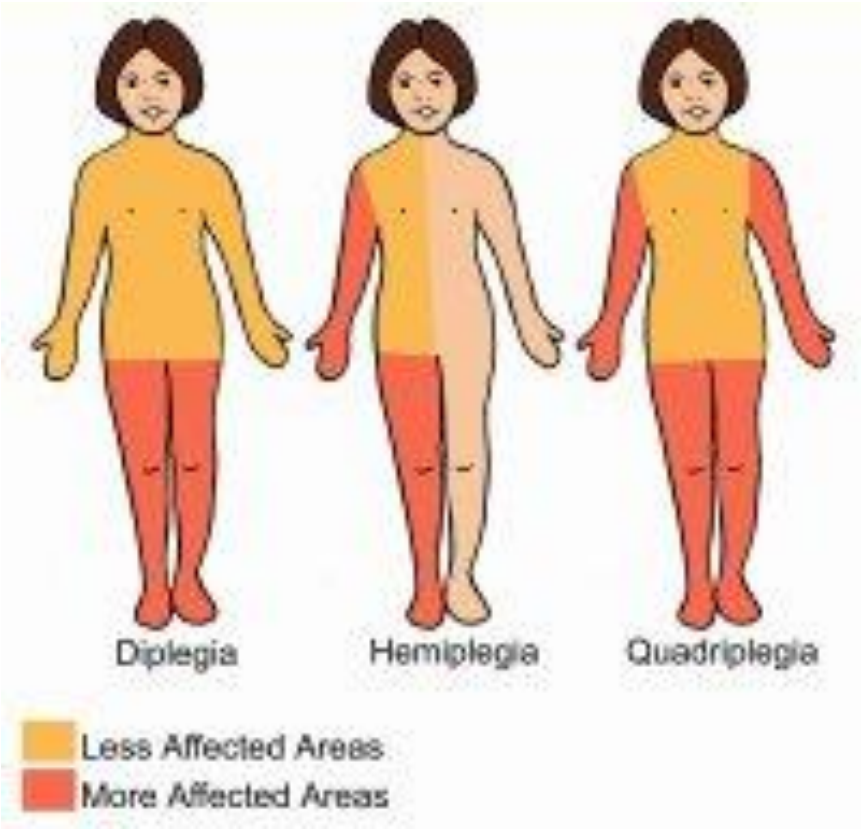
- Needs to be differentiated from those with identifiable causes of neonatal hypotonia:
  - Muscle disease
  - Metabolic disorders
  - Genetic syndromes
- Many of these children develop spastic or extrapyramidal-type disorders after the first few months of life.

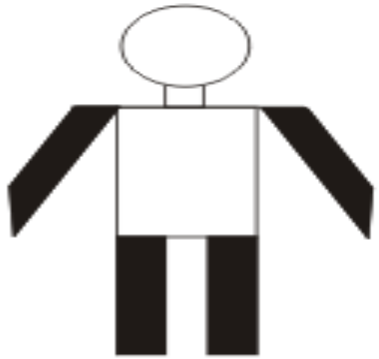
MIXED:

- Spasticity + Dystonia

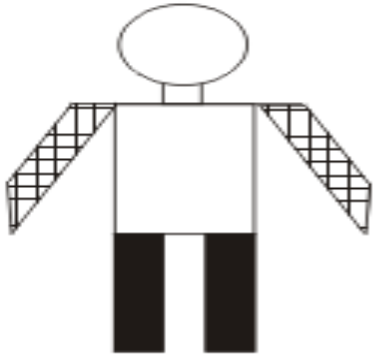
Cerebral Palsy: Topographic

- Monoplegic
- Paraplegic
- Hemiplegic
- Triplegic
- Quadraplegic
- Diplegia

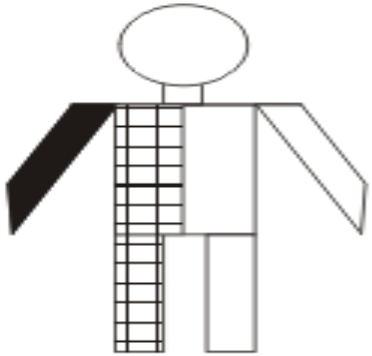




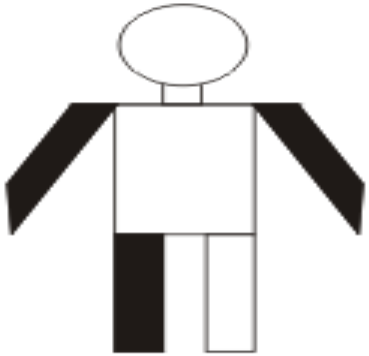
Qudriplegia
All four limbs are involved.



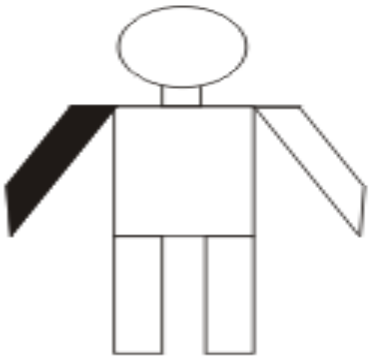
Diplegia
All four limbs are involved. Both legs are more severely affected than the arms.



Hemiplegia
One side of the body is affected. The arm is usually more involved than the leg.



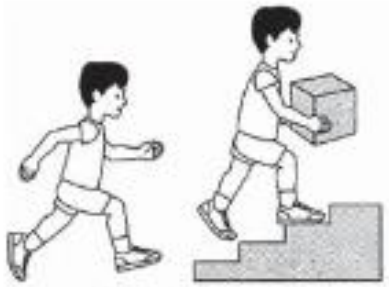
Triplegia
Three limbs are involved, usually both arms and a leg.



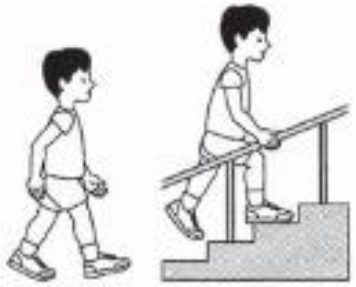
Monoplegia
Only one limb is affected, usually an arm.

GMF CLASSIFICATION

GROSS MOTOR FUNCTIONAL CLASSIFICATION	
LEVEL 1	Walks without restriction, Limitations in high-level skills
LEVEL 2	Walks without devices, Limitations in walking outdoors
LEVEL 3	Walks with devices, Limitations walking outdoors
LEVEL 4	Limited mobility, Power mobility outdoors
LEVEL 5	Very limited self-mobility, even with assistive technology



GMFCS Level I



GMFCS Level II

GMFCS Level III

GMFCS Level IV

GMFCS Level V

Assessment

Assessment

- Focus on child abilities
- What a child can do rather what he can not do
- Abnormal postural reflex activity
- Abnormal postural tone
- Eye ball observation
- DTRs
- Communication
- IEPs
- Goal setting
- Management is life long ,assessment & reassessment
- Child with CP does not born with disability but they have deformity-producing tendencies
- Environment should be child-friendly
- Assortment of toys
- Lose the white coat.

NORMAL

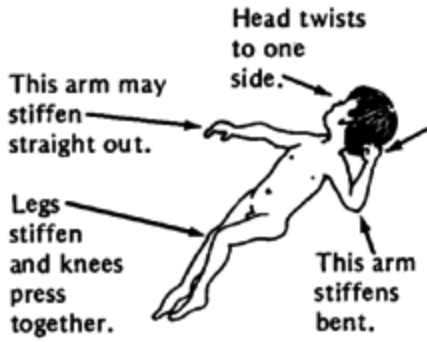
FLOPPY

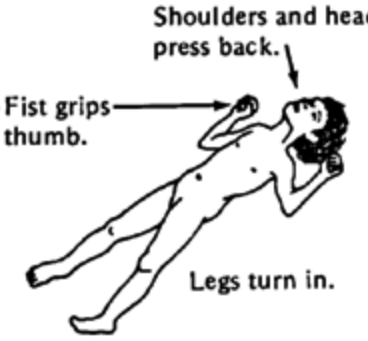
Child hangs in upside down 'U' with little or no movement.

Body stiffens like a board.

Even if a child can hear loud banging, he may not hear well enough to understand words.

When you try to stand the child the legs often stiffen or cross like scissors.





Typical athetoid arm and hand movements may be as a regular shake or as sudden 'spasms'. Uncontrolled movements are often worse when the child is excited or tries to do something.

This child has severe athetosis.

To keep her balance the child with ataxia walks bent forward with feet wide apart. She takes irregular steps, like a sailor on a rough sea or someone who is drunk.

TEST FOR ATAXIA:

Hold a finger or a toy in front of the child and ask him to touch it on the first try. The child with ataxia cannot do it.

CEREBRAL PALSY

AND

REHABILITATIONS

- Maximum normalization
- What you can do for child
- Management is life long
- Communication
- Counteract the abnormal tone and reflexes
- Facilitation of normal patterns of movements
- Functional pattern of movement and incorporate in daily life activities
- Encourage active movements and dis courage automatic or reflex movement
- Brain represent movements not muscle…so there is loss of movement rather paralysis of muscle

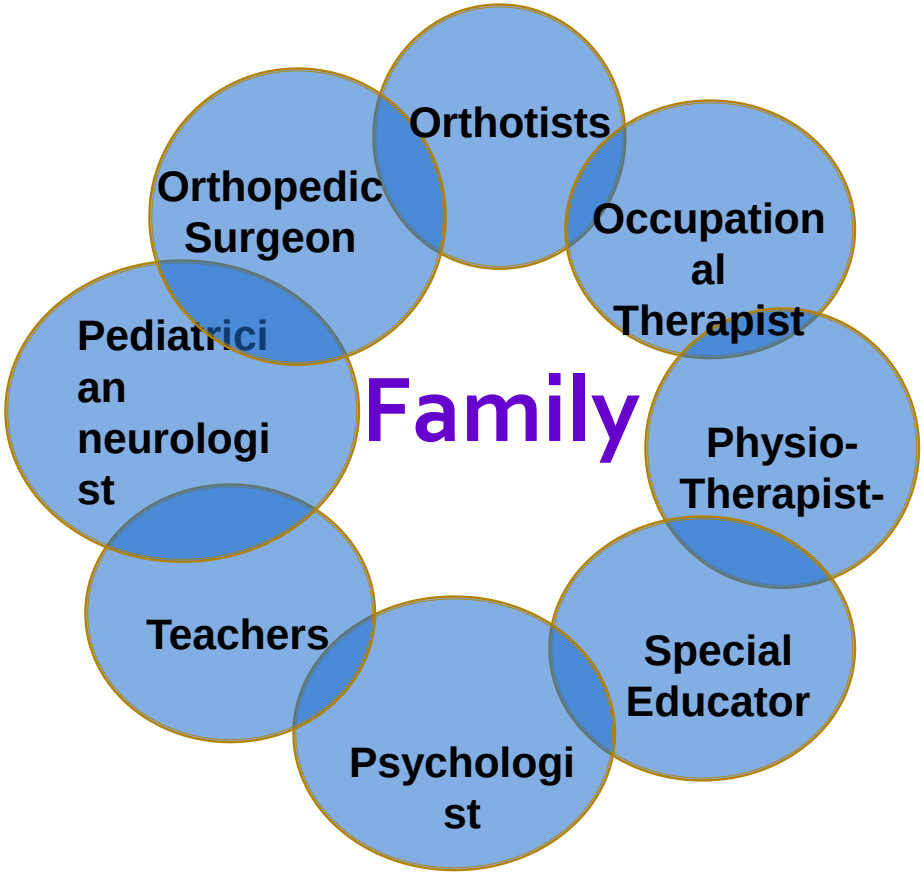
REHABILITATION:

- **Rehabilitation** is combined and coordinated use of medical , therapeutic , social , educational and vocational measures for **training or retraining** the individual to highest possible level of function

CEREBRAL PALSY: MANAGEMENT

- Physical therapists
- Occupational therapist
- Neurologic and Physiatric
- Speech therapist
- Adaptive equipment
- Surgical
- Rhizotomy, Baclofen pumps, Botoxin

Multidisciplinary Team


Orthotists
Orthopedic Surgeon
Occupational Therapist
Pediatrician neurologist
Family
Physio-Therapist-
Teachers
Special Educator
Psychologist

Abnormalities of oral motor function and dysphagia

- Due to weakness and incoordination of lips, tongue and masticatory and facial muscles.
- Drooling, dysphagia and dysarthria
- Treatments:
  - Behavioral techniques
  - Speech therapy
  - Anticholinergic medications
  - Botulinium toxin A injections
  - Surgical redirection of the salivary ducts

Under nutrition/ Malnutrition

- 1/3 of patients with Hemiplegia and Diplegia (undernourished)
- > 2/3 of patients with Quadriplegia (undernourished)
- 27% of patients – malnourished
- Treatment:
  - Gastrostomy

CHRONIC CONSTIPATION

- Neuromuscular control of the bowel
- Exaggerated by immobility and abnormal diet and fluid intake
- Treatment:
  - Increase activity
  - Increase fluid and fiber intake medications

Other problem:

Gastroesophageal reflux:

Urinary Symptoms:

1/3 of patients – frequency, incontinence or difficulty urinating.

Cognitive Impairments:

- 30% of patients- mental retardation
- Risk is directly proportional to severity of motor disability.
- 20-30% - have specific learning disabilities

Seizure Disorders

- 1/3 of children with CP
- Hemiplegic> Quadri > Diplegic
- Reflects a greater extent of cortical brain injury
- Treatment:
  - Antiseizure techniques

Other problem(cont….)

Osteoporosis

- Secondary to the following factors:
  - Feeding difficulties – deficient Ca and Vit D
  - Decreased weight bearing/ Immobilization
  - Muscle stresses
  - Antiseizure meds
  - Weight percentile/ Low triceps skinfold
- Treatment:
  - Ca and Vit D supplementation
  - Bisphosphonates (Pamindronate)

interventions

Cerebral palsy

Neurodevelopmental Therapy (NDT)

Moving through normal movement patterns to experience normal movement

Major components : reflex-inhibiting posture, inhibition of abnormal reflexes, normalization of muscle tone, and adherence to normal developmental sequence of motor progression

NDT

- Inhibiting abnormal movement patterns.
- Facilitating normal movement patterns.

Strong evidence that supports the effectiveness of NDT for children with CP with respect to normalizing muscle tone , increasing rate of attaining motor skills, and improving functional motor skills

Butler C, Darrah J: Effects of Neurodevelopmental treatment (NDT) for cerebral palsy: An AACPDM evidence report. Dev Med Child Neurol 2001 ; 43: 778 - 790

Sensory Integration Therapy

Principle: a neurobiological process organizes sensation from one's own body and from environment and makes it possible to use the body effectively within environment

Emphasis on importance of three body centered sensory systems : tactile , proprioceptive & vestibular

SI Therapy

Constrained - Induced Movement Therapy

- Constraining non-affected arm to encourage performance of therapeutic task with the affected arm, which children normally tend to disregard.
- child's brain is plastic and can respond to intense training
- Systematic review has found the effectiveness of CIMT for children with hemiplegic CP.

CIMT

Constraint-induced movement therapy (CIMT) is a form of rehabilitation therapy that improves upper extremity function in stroke and other central nervous system damage victims by increasing the use of their affected upper limb.

Among patients who had a stroke within the previous 3 to 9 months, CIMT produced statistically significant and clinically relevant improvements in arm motor function that persisted for at least 1 year.

The patient engaging in repetitive exercises with the affected limb, the brain grows new neural pathways. This change in the brain is referred to as cortical reorganization or neuroplasticity.

Constraint-induced movement therapy (CIMT) coupled with intensive and varied exercise training has proven to be effective in reducing spasticity and increasing function of the hemiplegic upper extremity in chronic stroke patients.

For any query visit:
www.rehabtrain.com

Rehab Train

Serial casting

- Serial casting may serve to reduce spasticity in muscles by decreasing the strength of abnormally strong tonic foot reflexes.

- Serial casting in the CP population has been shown to improve ROM.
- Casting provides stability and prolonged stretch of a muscle which is immobilized in a lengthened position.
- At least 6 hrs of prolonged stretch is needed for effectiveness.

Botox + serial casting

- Botox reduces spasticity and improves ambulatory status.(Flett 1999)
- When used in combination with serial casting it has shown to help maintain and improve muscle length and passive ROM.(Kay 2004)
- Without conservative interventions such as serial casting, (with & without botox injection) more expensive procedures may be necessary. (Flett 1999)

Body Weight Supported Treadmill Training

Uses theories of motor learning & importance of early task –specific training

Theory : activate spinal & supraspinal pattern generators for gait

Strengthening

Progressive resisted exercise improves muscle performance & functional outcomes in CP children

Research had supported effectiveness on increasing force production in CP

Dodd et.al. systematic review of strengthening for individuals with cerebral palsy . Arch Phys Med Reh,83:1157-1164, 2002

Intervention Philosophies & strategies

NMES

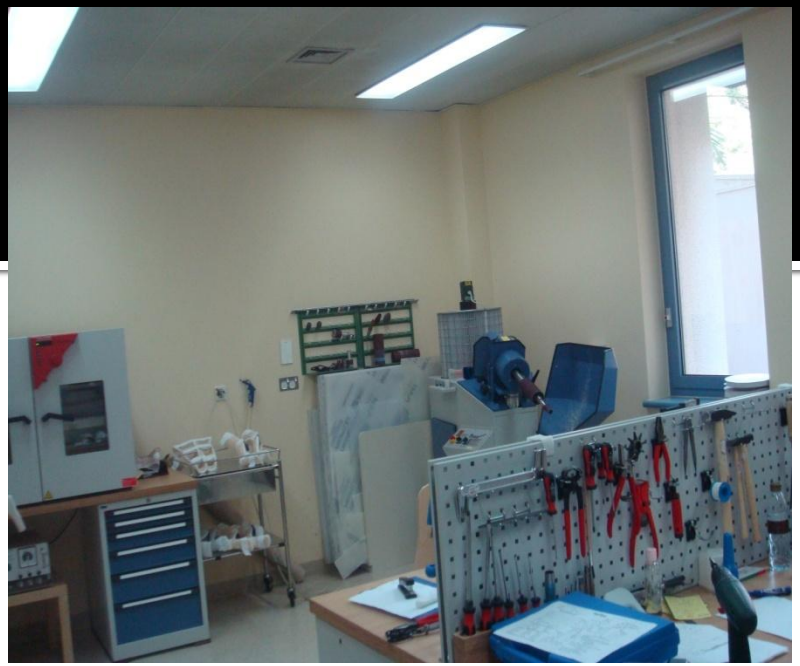
Multiple studies have demonstrated the effectiveness of NMES,

- Reduce spasticity.
- Increase ROM & strength.
- Increase force production.
- Promote initial learning of selective motor control.

Orthotic devices , splints , cast

Goals :

- Maintenance or increase ROM
- Protection or stabilization of a joint
- Promotion of joint alignment
- Promotion of function



Ankle Foot Orthosis

- Compared with barefoot gait, AFO's enhanced gait function in diplegic subjects. Benefits resulted from elimination of premature PF and improved progression of foot contact during stance.

Assistive Technology & Adaptive Equipment

- Optimizes alignment, posture & function.
- Inhibits spasticity patterns.
- Facilitates more normal movement.

Adjunct therapies

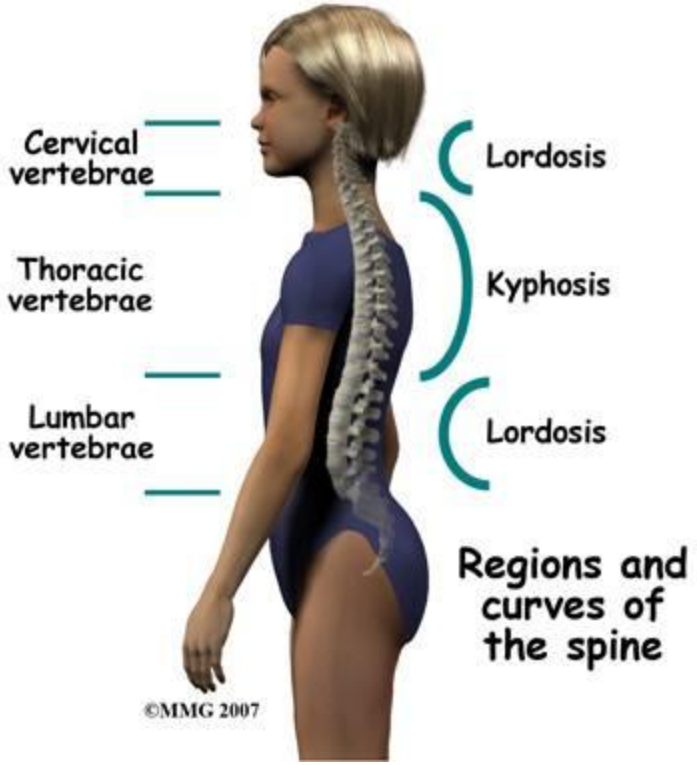
- Hippotherapy.
- Aquathearpy.
- suits.
- Theratogs.

Speech & Language Therapy

- Oralmotor function using strengthening / Intraoral stimulation
- verbal (PROMPT) & non-verbal communication skills (PECS)
- auditory training for HI
- audiometry screening
- swallowing function

Cerebral palsy and posture

Posture is the extent to which the body is maintained in alignment with a variety of positions.



Ideal Posture

90 degree RULE

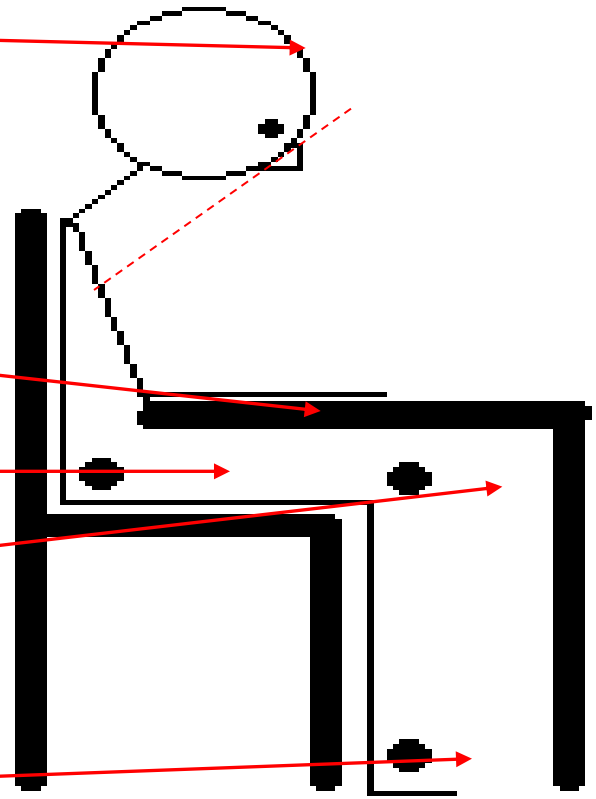
Head is upright

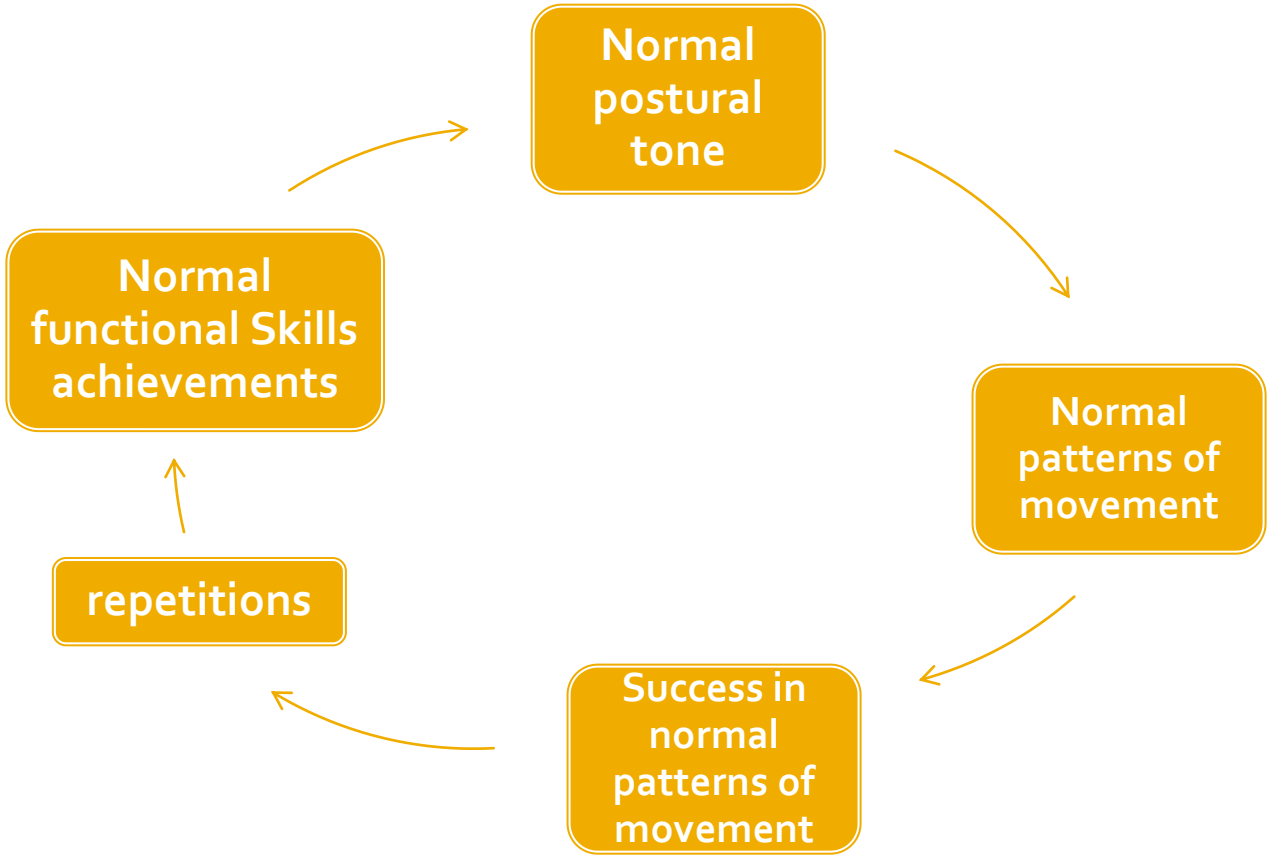
Table at elbow height

Pelvis in neutral

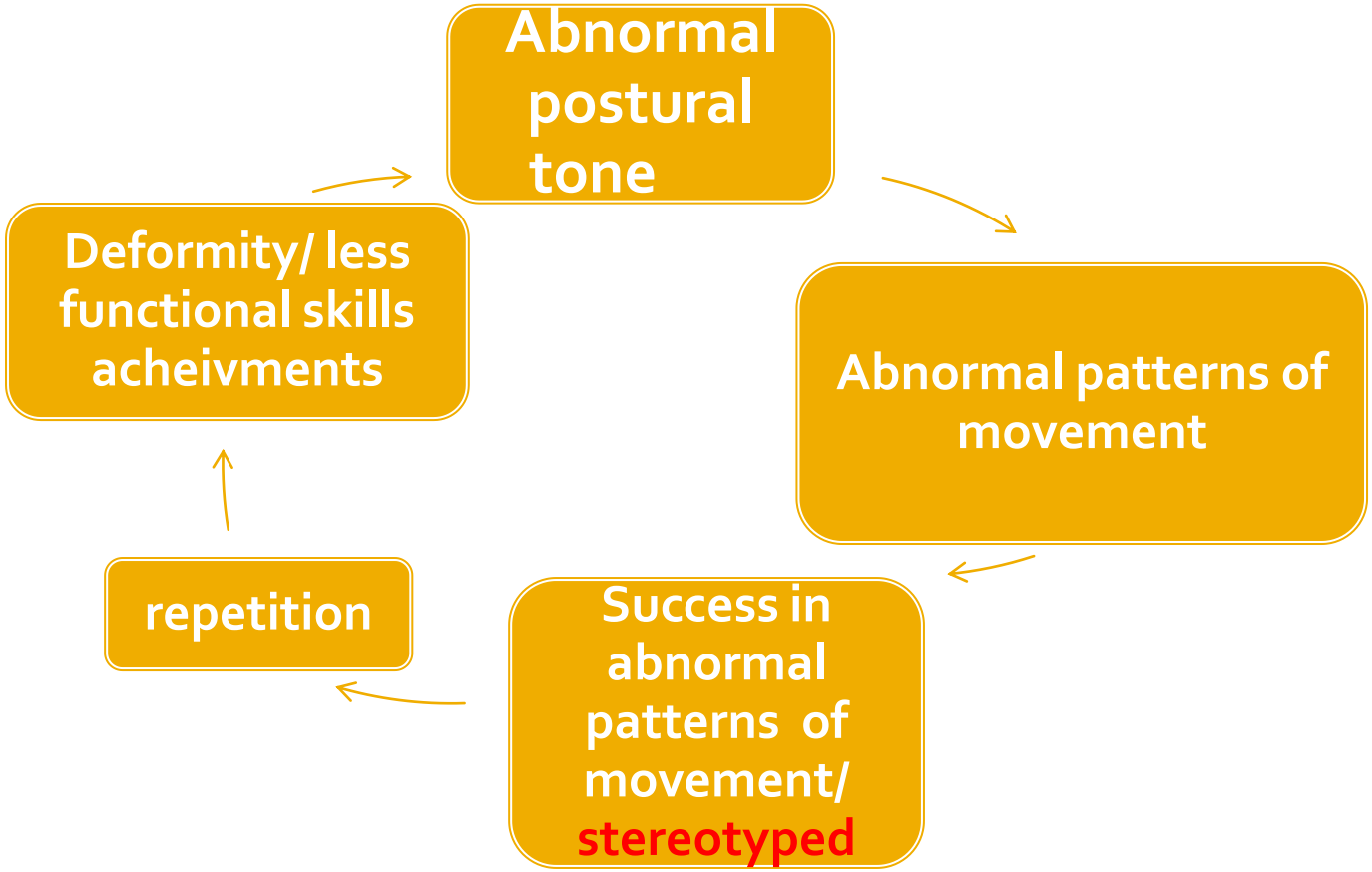
Knees at 90^{o}

Feet flat on floor or footrest




Normal postural tone
Normal patterns of movement
Success in normal patterns of movement
repetitions
Normal functional Skills achievements

CP?


Abnormal postural tone
Abnormal patterns of movement
Success in abnormal patterns of movement/ stereotyped
repetition
Deformity/ less functional skills acheivments

Normal postural reflex mechanism

Rightening reactions:

From birth-10th ,12th month----modification----inhibition----5th year disappear

Position of head in space, alignment of head neck and trunk

1. Neck Rightening:

Turn the head one side----body also move same side….present at birth

2.Labyrinthine reaction on head:

4-6 week onwards----initially weak and raising head from prone

Strengthen ….from supine

3. Body Rightening on head:

Interact with labyrinthine and position of body rightens the head position

Touching feet with ground secure the head

4. Body Rightening reaction on body:

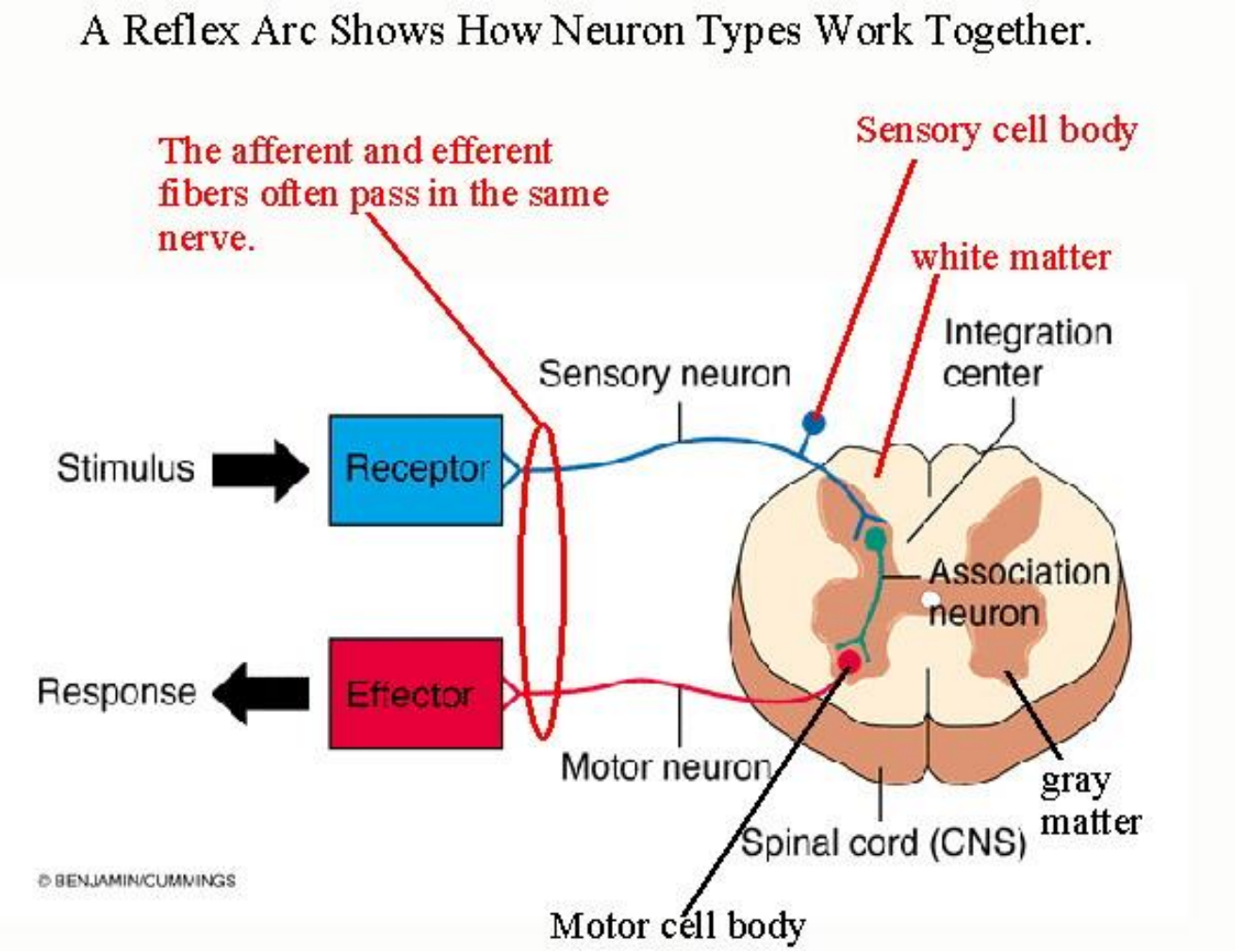
Appear 6-8 moth

Modified neck Rightening

5. Optical Rightening reactions

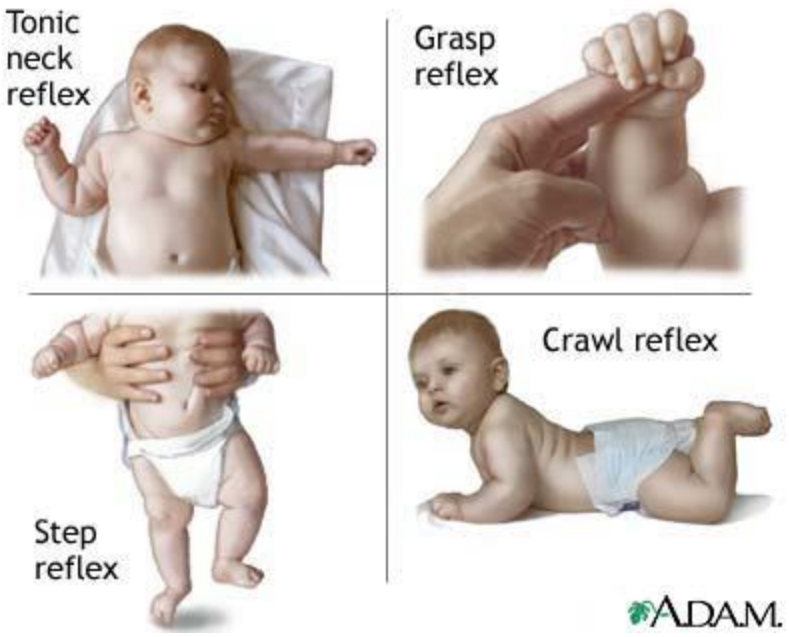
Primitive reflexes

Reflex action:



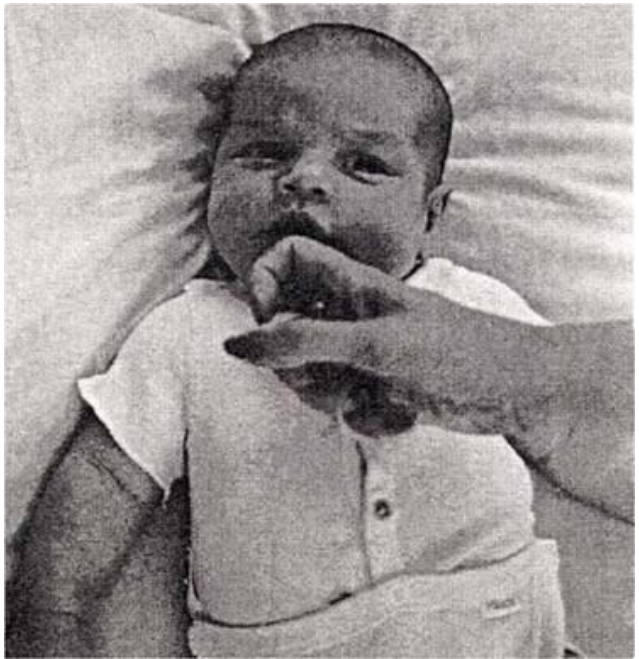
NEONATAL Reflexes ~ Palmar Grasp

Stimulus / Response	S: Palm stimulated R: 4 fingers (not thumb) close
Duration	5 months gestation - 4 months postpartum
Concerns	No palmer grasp may indicate neurological problems (spasticity)
Other	One of the most noticeable reflexes May lead to voluntary reaching / gras May predict handedness in adulthood


Tonic neck reflex
Grasp reflex
Step reflex
Crawl reflex
A.D.A.M.

Primitive Reflexes ~ Sucking

Stimulus / Response	S: touch of lips R: sucking action
Duration	In utero - 3 months postpartum
Concerns	No reflex problematic for nutrition
Other	Often in conjunction with searching reflex



Primitive Reflexes ~ Moro

Stimulus / Response	S: Suddenly but gently lower baby's head S: Hit surface beside baby R: Arms and legs extend
Duration	Prenatal – 4-6 months postpartum
Concerns	May signify CNS dysfunction if lacking May signify sensory motor problem if persists May delay sitting & head control if persists May indicate injury to one side of brain if asymmetical
Other	Reaction time increases with age Preceeds startle refle

Positive supporting

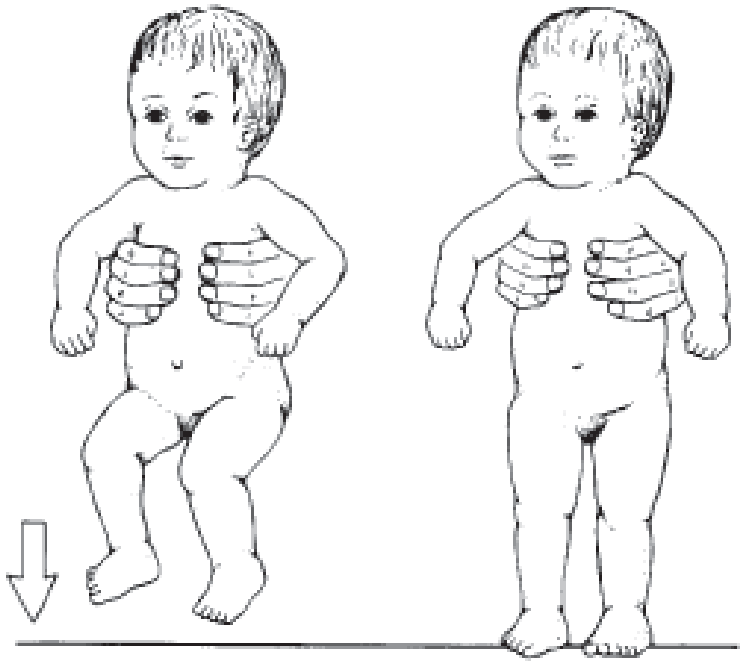


Figure 15.3 The positive support reflex.

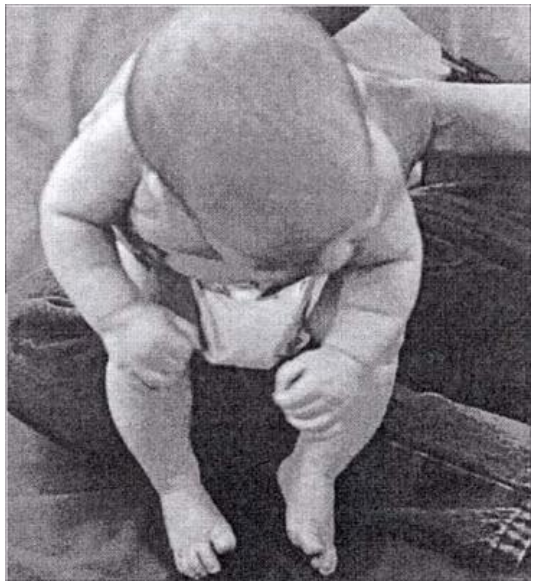
Primitive Reflexes ~ Asymmetric Tonic Neck

Stimulus / Response	S: Prone/supine position, turn head to one side R: Limbs flex on one side, extend on other side
Duration	After birth – 3 months
Concerns	Facilitates bilateral body awareness Facilitates hand-eye coordination
Other	Also called 'bow and arrow' or 'fencer's' position

Asymmetric Tonic Neck

Primitive Reflexes ~ Symmetric Tonic Neck

Stimulus / Response	S: Baby sitting up and tip forward R: Neck and arms flex, legs extend S: Baby sitting up and tip backward R: Neck and arms extend, legs flex
Duration	After birth – 3 months
Concerns	Persistence may impede many motor skills and cause spinal flexion deformities



Thanks you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