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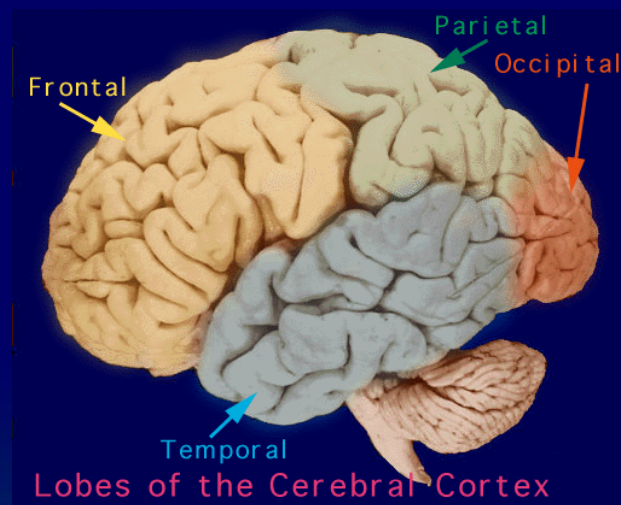
Is Cerebral Palsy Surgically Treatable Disease ?

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Definition of Cerebral Palsy

- ✓ Cerebral palsy is a term used to describe chronic movement or posture disorders
- ✓ **Cerebral** refers to the brain
- ✓ **Palsy** refers to a physical disorder

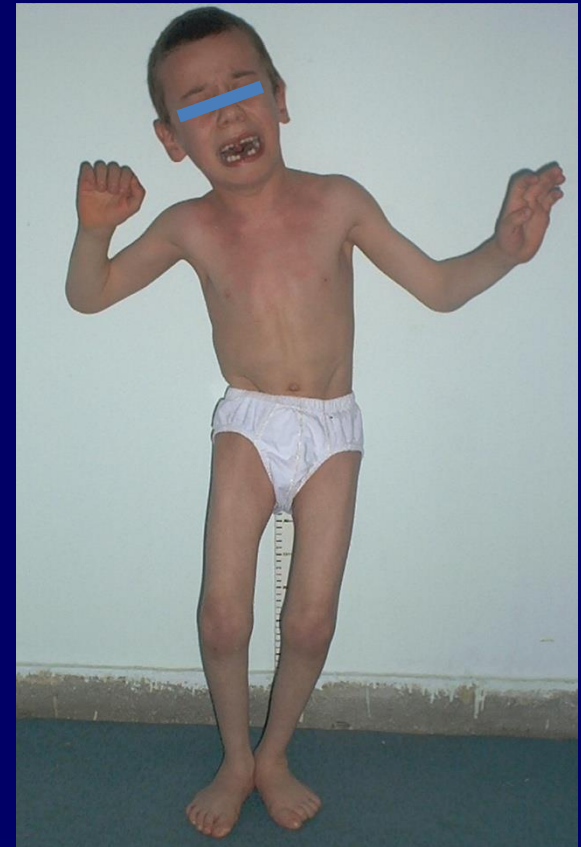


Definition of Cerebral Palsy

- ✓ Static encephalopathy
- ✓ Non-progressive central nervous system disorder
- ✓ Progressive musculoskeletal system pathology
- ✓ Impairment of control of movement and posture

In Cerebral Palsy...

- ✓ Impossible to correct the brain damage
- ✓ Orthopaedic and biomechanical problems develop secondary to this disorder
- ✓ Some problems will continue lifelong

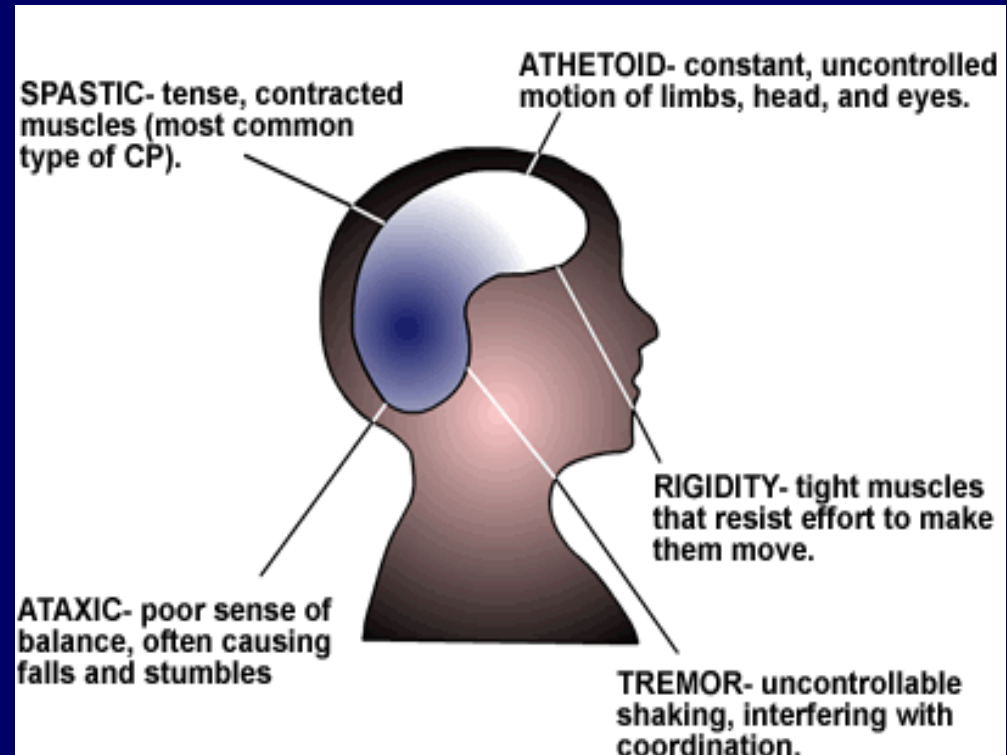


We must know...

- ✓ What can we not able to treat ?
- ✓ Which of the pathologies can we control ?
- ✓ What can we treat ?

Types of Cerebral Palsy

- ✓ Spasticity
- ✓ Athetosis
- ✓ Ataxia
- ✓ Hypotonia
- ✓ Mixed



Types of Cerebral Palsy

- ✓ Spasticity
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Cerebral palsy without treatment

Progression of the deformity

Hypotonia - Spasticity

Dynamic deformity

Static deformity and fix contracture

Bone and joint deformities

The goals of treatment

- ✓ Improvement of life quality
 - ✓ Motion without assistance and pain
 - ✓ Sitting and individual care
 - ✓ Functional development, independent walking and working

The goals of treatment

- ✓ Correct posture and walking
 - ✓ Balanced and stable spine and pelvis
 - ✓ Extension ability for hip and knee joints in stance phase
 - ✓ Plantigrade feet

Orthopaedic management for...



Spasticity

Contracture

Bone and joint deformities

Orthopaedic management in ambulatory child



- ✓ To preserve or improve function
 - ✓ Facilitating movement
 - ✓ Maintaining a functional posture
 - ✓ Preventing deformity
 - ✓ Preventing and relieving discomfort
- ✓ Observation
- ✓ Orthotics
- ✓ Medical management
- ✓ Surgery



Orthopaedic management in non-ambulatory child



- ✓ Total body involvement
- ✓ Specific functional areas of concern
 - ✓ Posture for feeding
 - ✓ Respiratory hygiene
 - ✓ Bowel function
 - ✓ Sitting
 - ✓ Communication
- ✓ Specific anatomical areas of concern
 - ✓ Upper and lower extremities
 - ✓ Hip and spine



Clinical Decision-Making

Clinical history

Physical examination

Diagnostic imaging



Quantitative gait analysis

Examination under anesthesia

Davids RJ et al. Optimization of walking ability of children with cerebral palsy. J Bone Joint Surg (Am) 2003; 85(11): 2224 – 2234.

Treatment principles in Cerebral Palsy

Non-operative treatment

Physical therapy

Occupational therapy

Orthotics

Serial casting

Oral medication

Operative treatment

Primary treatment

Secondary treatment

Treatment principles in Cerebral Palsy

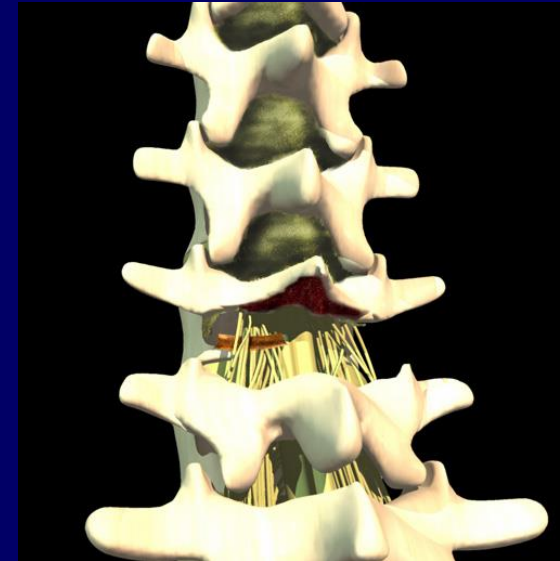
- ✓ Primary treatment – Neurological
 - Selective dorsal rhizotomy
 - Baclofen pump
 - Botulinum toxin treatment

- ✓ Secondary treatment – Orthopaedic
 - Correction of the biomechanics
 - Correction of the anatomy

SURGERIES FOR NEUROLOGICAL PROBLEMS

Primary treatment - Neurological

- ✓ Selective dorsal rhizotomy (SDR)
 - ✓ Neurosurgical operation
 - ✓ Laminoplasty from L1 to S1 and transection of 20% to 40% of the dorsal nerve rootlets
 - ✓ Pure spasticity
 - ✓ Good selective motor control
 - ✓ Adequate underlying muscle strength
 - ✓ Age 4 to 7 years
 - ✓ Spastic diplegia



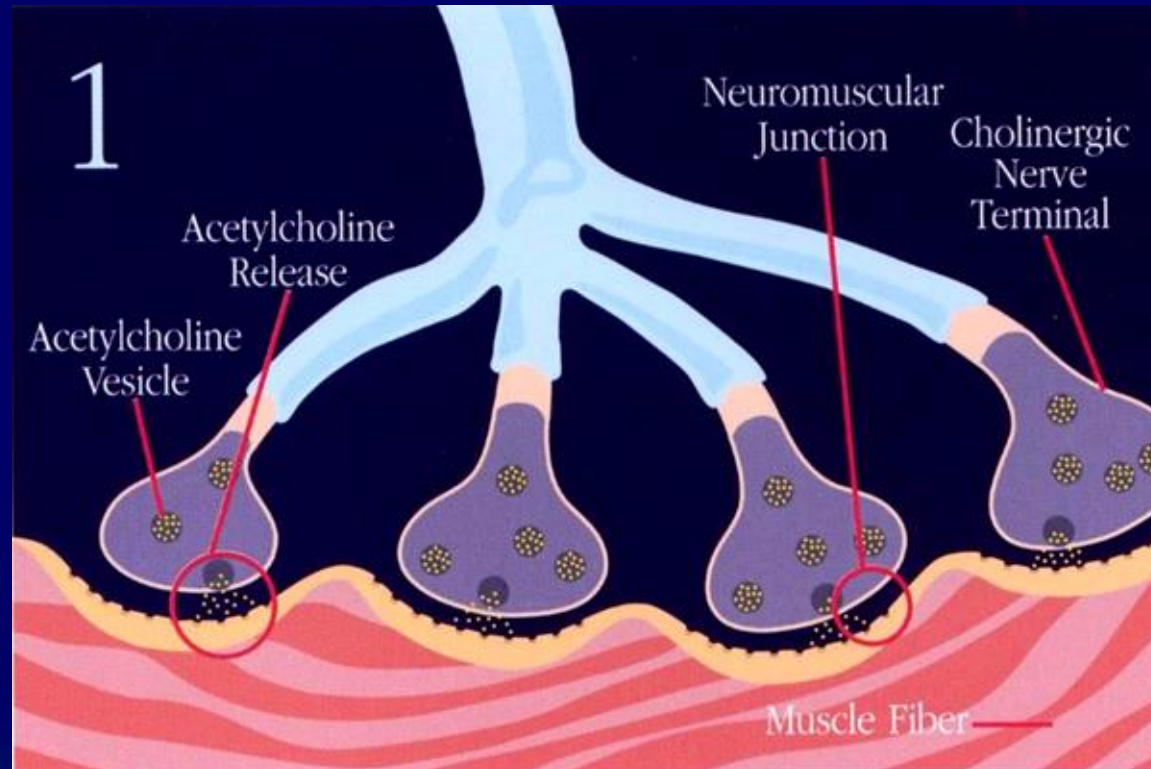
Primary treatment - Neurological

- ✓ **Baclofen pump**
 - ✓ Implanted pump which administers small quantities of Baclofen into the subarachnoid space
 - ✓ Severe spastic quadriplegia
 - ✓ Expensive
 - ✓ Invasive
 - ✓ Sometimes associated with life-threatening complications



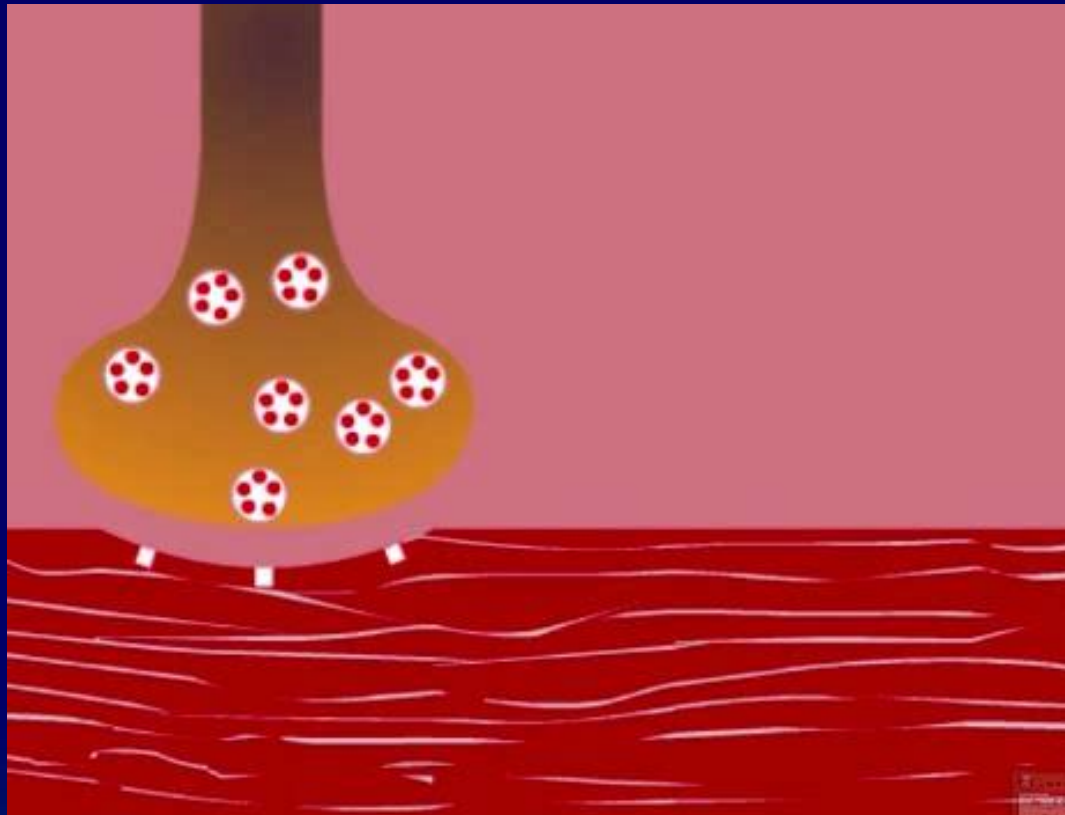
Primary treatment - Neurological

✓ Botulinum toxin treatment



Primary treatment - Neurological

- ✓ Botulinum toxin treatment



Primary treatment - Neurological

- ✓ The goals of Botulinum Toxin treatment

Control of spasticity

Prevent the development of static deformity
(contracture)

Primary treatment - Neurological

- ✓ The goals of Botulinum Toxin treatment
 - Weaken the spastic (agonistic) muscle
 - Strengthening antagonistic muscle



BALANCE OF MUSCLE FORCES

Primary treatment - Neurological

- ✓ Appropriate patient for Botulinum Toxin
 - ✓ Dynamic deformity
 - ✓ Pain due to spasticity
 - ✓ Pain after surgery or cast applications
 - ✓ Deformity secondary to muscle imbalance

Primary treatment - Neurological

- ✓ Inappropriate patient for Botulinum Toxin
 - ✓ Presence of contracture or static deformity
 - ✓ Allergy and hypersensitivity
 - ✓ Severe muscle weakness
 - ✓ Resistant patients to the previous injections
 - ✓ Patients used aminoglycoside, curare, calcium channel blockers

SURGERIES FOR ORTHOPAEDIC PROBLEMS

Orthopaedic surgical procedures

- ✓ Lengthen contracted myotendinous units
- ✓ Balance joint forces
- ✓ Transfer motor power
- ✓ Fuse unstable joints by arthrodesis
- ✓ Correct bony deformity to improve biomechanical alignment
- ✓ Reduce joint subluxation and dislocation to improve joint congruency
- ✓ Diminish painful spasticity
- ✓ Maintain, restore or stabilise spinal deformity

Secondary treatment - Orthopaedics

- ✓ Correction of the biomechanics
 - ✓ Muscle-tendon lengthening and transfers
 - Single event multilevel surgery (SEMLS) in children between 5-7 years old
 - Minimize the hospitalization time and duration of rehabilitation



Secondary treatment - Orthopaedics

- ✓ Correction of the biomechanics

- ✓ Lever arm dysfunction

Corrective osteotomies for foot, leg and pelvis

Additional to soft tissue procedures and
orthosis for lower extremity

Secondary treatment - Orthopaedics

- ✓ Correction of the anatomy
 - ✓ Mostly for quadriplegic, sometimes for diplegic patients
 - ✓ Scoliosis
 - ✓ Hip dislocation
 - ✓ Joint contractures
 - ✓ Foot problems



Topographical distribution

- ✓ Monoplegia
- ✓ Hemiplegia
- ✓ Diplegia
- ✓ Triplegia
- ✓ Quadriplegia
- ✓ Double hemiplegia

Topographical distribution

Monoplegia

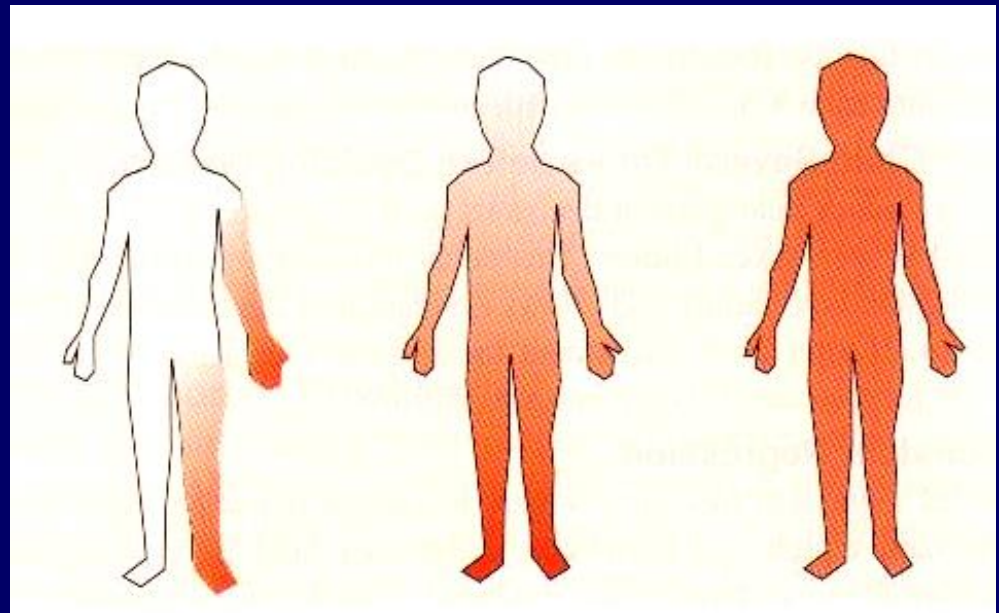
✓ Hemiplegia

✓ Diplegia

Triplegia

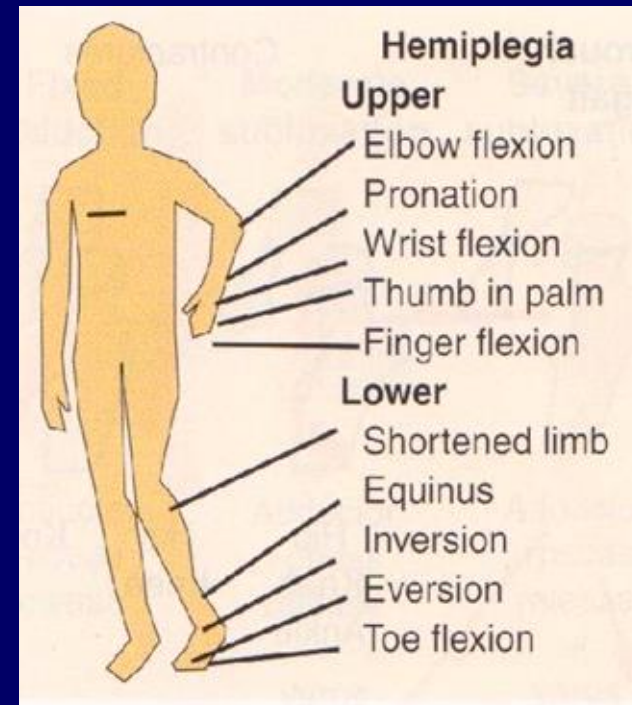
✓ Quadriplegia

Double hemiplegia



Hemiplegic patient

- ✓ 20-25% of cases with spastic CP
- ✓ Upper extremity > lower extremity
- ✓ Distal part > proximal part
- ✓ Very few associated problems
- ✓ Hip dislocation and scoliosis are very rare (3%)
- ✓ Generally independent in the activities of daily living



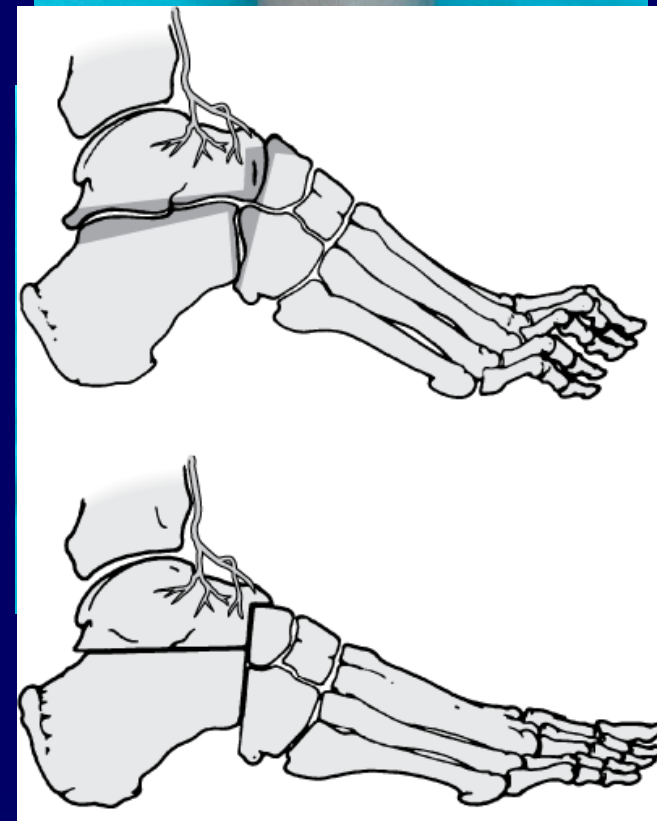
Hemiplegic patient

- ✓ Bone and joint procedures generally for lower extremity
- ✓ Pes varus
 - ✓ Tendon transfer
 - ✓ Lateral calcaneal close wedge osteotomy
 - ✓ Triple arthrodesis

Increased femoral anteversion

Proximal or distal femoral derotation osteotomy

Be careful for compensatory increased tibial external torsion



Hemiplegic patient

- ✓ Bone and joint procedures generally for lower extremity

Pes varus

Tendon transfer

Lateral calcaneal close wedge osteotomy

Triple arthrodesis

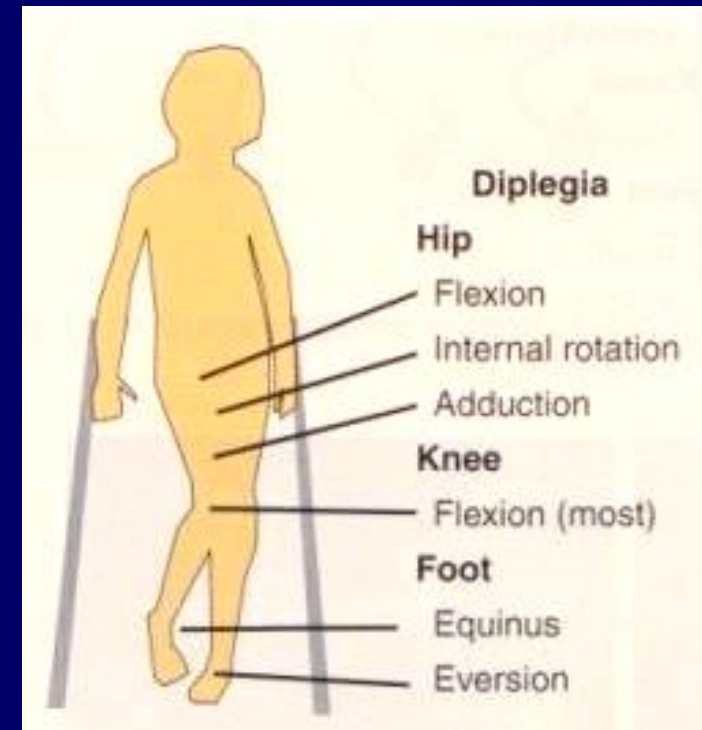
- ✓ Increased femoral anteversion

- ✓ Proximal or distal femoral derotation osteotomy
- ✓ Be careful for compensatory increased tibial external torsion



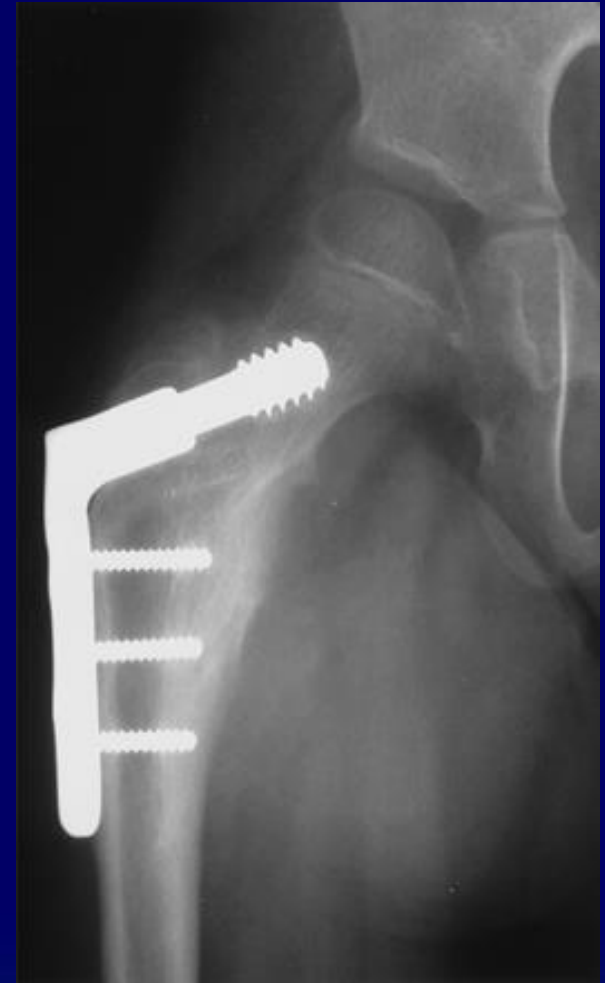
Diplegic patient

- ✓ 40-50% of cases with spastic CP
- ✓ Walking difficulty
- ✓ Abnormal gait patterns
- ✓ Trunk imbalance
- ✓ Risk for hip instability (10%)
- ✓ Among all types of CP, most benefit from treatment procedures



Diplegic patient

- ✓ Hip instability
 - ✓ Femoral osteotomies in addition to hip adductor and flexor release



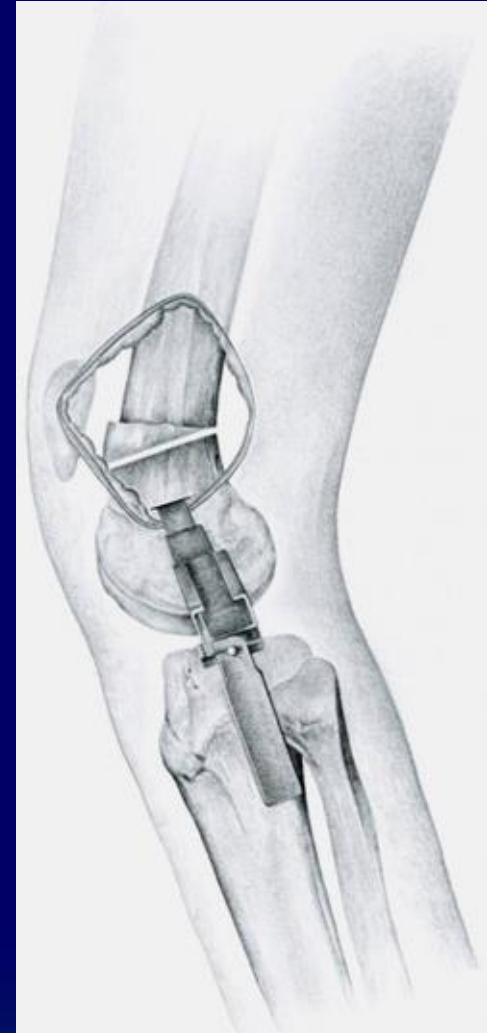
Diplegic patient

- ✓ Internal torsion deformity in lower limb
 - ✓ Proximal or distal femoral derotation osteotomy
 - ✓ Tibial derotation osteotomy



Diplegic patient

- ✓ Knee flexion contracture
 - ✓ Supracondylar femoral extension osteotomy



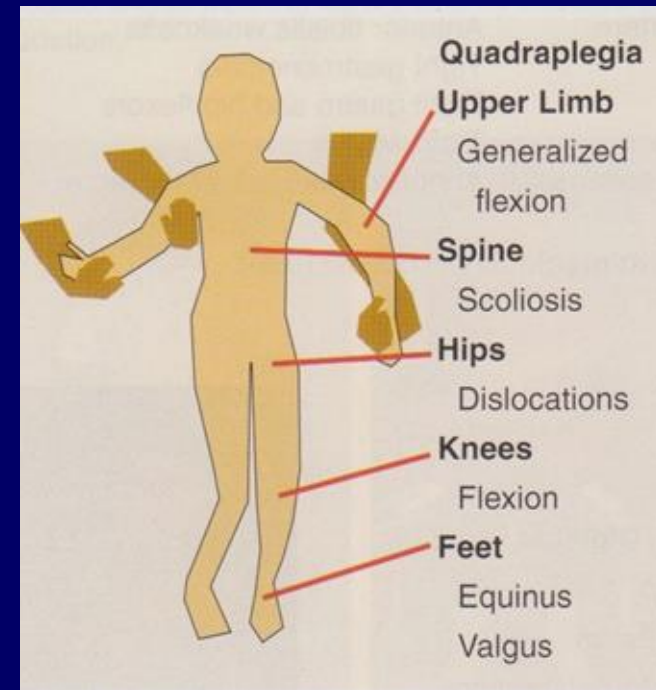
Diplegic patient

- ✓ Pes planovalgus
 - ✓ Dennyson-Fullford subtalar arthrodesis
 - ✓ Grice-Green extraarticular arthrodesis
 - ✓ Calcaneal lengthening osteotomy
 - ✓ Triple arthrodesis
- ✓ Hallux valgus
 - ✓ Metatarsal osteotomies
 - ✓ Metatarsophalangeal arthrodesis



Quadriplegic patient

- ✓ Involvement of neck, trunk and all four extremities; total body involvement
- ✓ Mental retardation, visual deficits, speech and hearing problems
- ✓ Inability to balance the trunk
- ✓ Hip and spine deformities
- ✓ Lower extremity contractures



Quadriplegic patient

- ✓ Goals of treatment
 - ✓ Prevent or correct hip and spine deformities
 - ✓ Obtain and maintain sitting balance
 - ✓ Facilitating care of the patient

Straight spine, horizontal pelvis
Stable and painless hip joint with 30° - 90° of flexion
Knee flexion between 20° - 90°
Plantigrade feet

Quadriplegic patient

- ✓ Scoliosis
 - ✓ Most common spinal deformity
 - ✓ Early onset and progressive
 - ✓ Cannot be controlled by orthotics



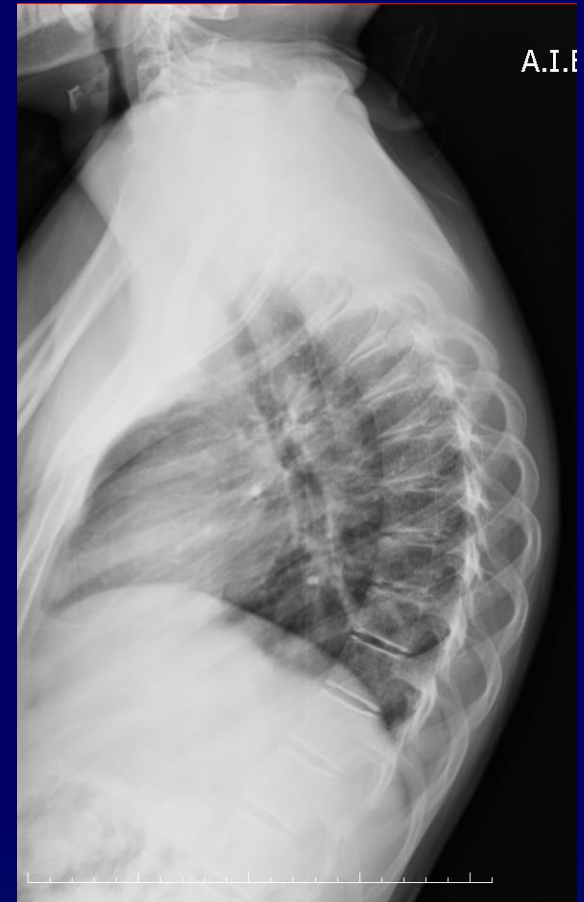
Quadriplegic patient

- ✓ Scoliosis
 - ✓ Posterior instrumentation and fusion
 - ✓ Anterior – posterior combined surgeries



Quadriplegic patient

- ✓ Hyperkyphosis
 - ✓ Disturbance in sitting balance
 - ✓ Hamstring contracture
 - ✓ Hamstring lengthening
 - ✓ Posterior instrumentation and fusion in curves greater than 70°



Quadriplegic patient

- ✓ Hyperlordosis
 - ✓ Hip flexion contractures
 - ✓ Hip flexor release
 - ✓ If rigid, posterior instrumentation and spinal fusion



Quadriplegic patient

- ✓ Hip instability
 - ✓ Affects hygiene, sitting and gait
 - ✓ Pain at early adulthood
 - ✓ Progressive unless treated
 - ✓ Degenerative changes
 - ✓ Secondary scoliosis



Quadriplegic patient

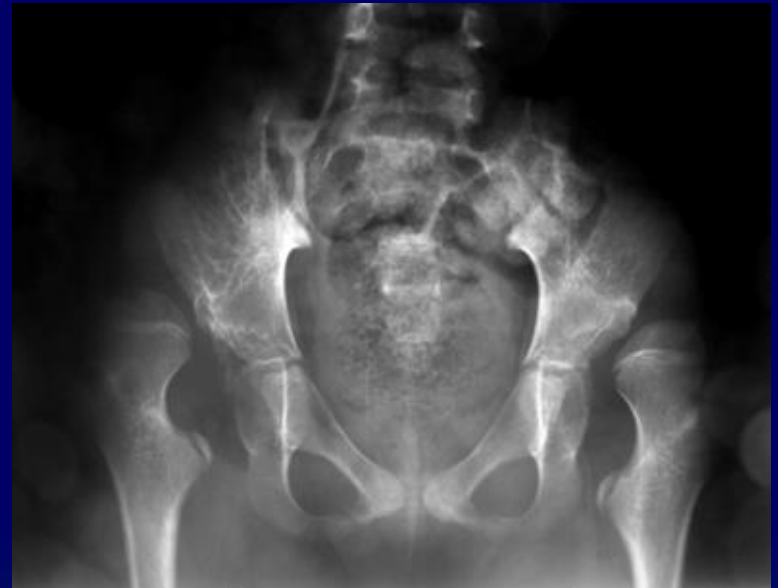
✓ Hip instability

Hip at risk

Hip subluxation



Hip dislocation



Quadriplegic patient

- ✓ Hip instability
 - ✓ Early intervention – minor surgical approaches



Quadriplegic patient

- ✓ Hip instability
 - ✓ Delayed intervention – major surgical approaches



Quadriplegic patient

- ✓ Hip instability
 - ✓ If no chance for reconstructions
 - ✓ Salvage procedures such as trochanteric valgus osteotomy, resection or interposition arthroplasty



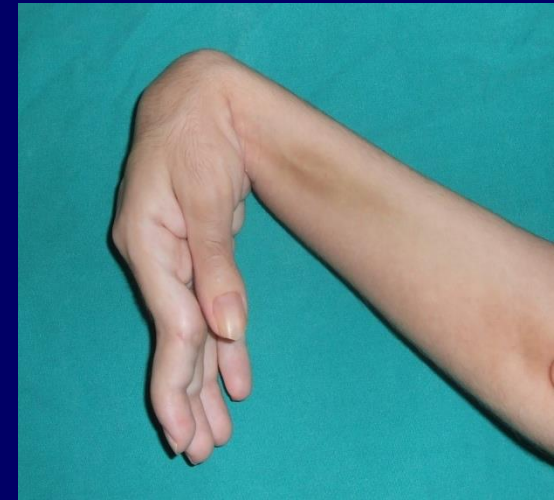
Quadriplegic patient

- ✓ Knee flexion contracture
 - ✓ Supracondylar femoral extension osteotomy

- ✓ Pes equinovarus – pes planovalgus
 - ✓ Soft tissue surgery, osteotomy, subtalar – triple arthrodesis

Upper extremity surgery

- ✓ Ideal surgical candidate
 - ✓ Voluntary hand use
 - ✓ Good sensation
 - ✓ Intelligent
 - ✓ No athetosis
- ✓ Surgery between 6 – 12 years of age
- ✓ Mostly hemiplegic, some times quadriplegic patients
- ✓ Muscle-tendon lengthening, tendon transfers, osteotomies and fusions can be required



We must know...

- ✓ What can we not able to treat ?
- ✓ Which of the pathologies can we control ?
- ✓ What can we treat ?

Not treatable...

✓ Brain damage



Controllabe...

- ✓ Primary motor problems
 - ✓ Spasticity



Treatable...(or correctable...)

- ✓ Secondary problems
 - ✓ Contractures
 - ✓ Bone and joint deformities



Is Cerebral Palsy curable disease?

NO

Associated problems

- ✓ Seizures
- ✓ Visual impairments
- ✓ Intellectual impairment
- ✓ Learning disabilities
- ✓ Hearing problems
- ✓ Communication problems and dysarthria
- ✓ Oromotor dysfunction
- ✓ Gastrointestinal problems and nutrition
- ✓ Teeth problems
- ✓ Respiratory dysfunction
- ✓ Bladder and bowel problems
- ✓ Social and emotional disturbances

Don't forget...

- ✓ Multidisciplinary team working
 - ✓ Physical rehabilitation
 - ✓ Pediatric neurology
 - ✓ Ophthalmology
 - ✓ Psychiatry
 - ✓ Hand rehabilitation
 - ✓ Occupational therapies

Thank you...



- ✓ Molenars G, et al. The effects of quantitative gait assessment and Botulinum Toxin A on musculoskeletal surgery in children with cerebral palsy. J Bone Joint Surg (Am) 2006; 88(1): 161 – 169.
- ✓ Wenger DR and Rang M. The art and practice of children's orthopaedics. New York: Raven Press; 1993.