

# 430 ORTHOPEDICS

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## Lecture: Common Pediatrics Lower Limb Deformities.

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**Black:** Slides (by Dr. Zamzam)

**Green:** My notes (recording)

**Red:** Important

**Blue:** Extra notes (429 – webmd)

MC/MCC: Most common cause

ST: Soft tissue - IR: Internal Rotation – ER: External Rot.

# 1 COMMON PRESENTATIONS

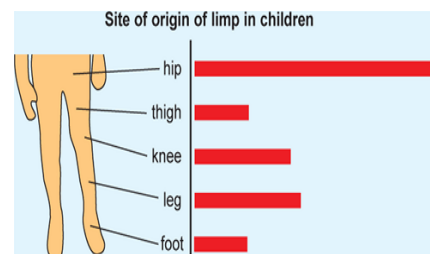
## 1.1 LEG ACHES

- History
  - It's a growing pain
  - With no functional disability
  - Benign
  - It resolves spontaneously
  - Unknown cause
- Screening Examination
- Tenderness Joint Motion
- Diagnosis by exclusion
- Differential Diagnosis from serious problems mainly tumor
  - Osteoid osteoma
  - Osteosarcoma
  - Ewing sarcoma
- Management
  - Symptomatic
  - Reassurance

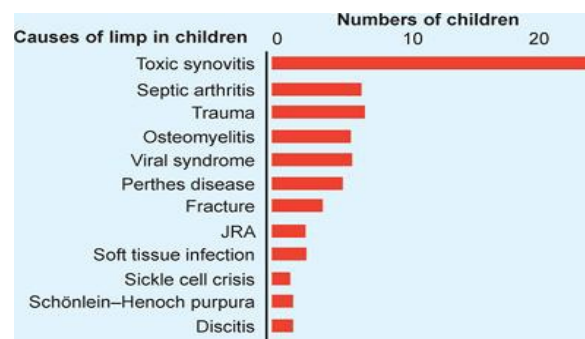
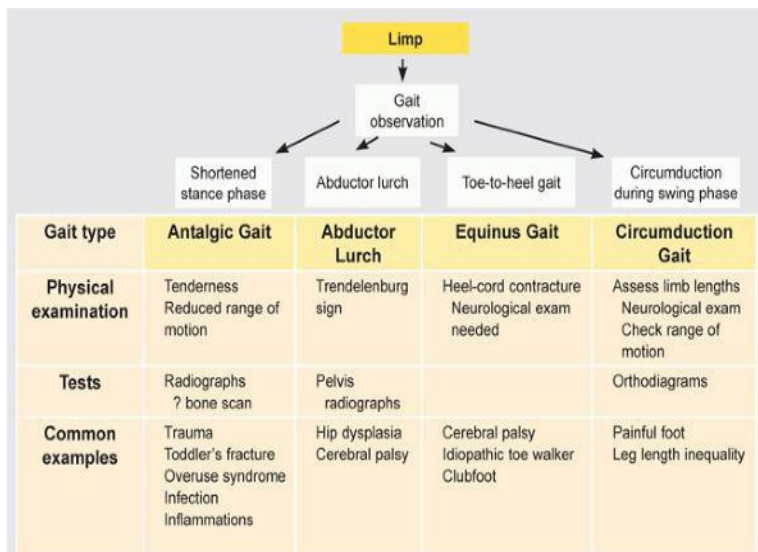
Feature	Growing Pain	Serious Problem
History		
Long duration	Often	Usually not
Pain localized	No	Often
Pain bilateral	Often	Unusual
Alters activity	No	Often
Causes limp	No	Sometimes
General health	Good	May be ill
Physical Examination		
Tenderness	No	May show
Guarding	No	May show
Reduced range of motion	No	May show
Laboratory		
CBC	Normal	± Abnormal
ESR	Normal	± Abnormal
CRP	Normal	± Abnormal

## 1.2 LIMPING

- Abnormal gait due to pain, weakness or deformity
- Evaluation
  - History (Mainly age of onset)
  - Observation
- Evaluate the limp by studying the child's gait while the child walks in the clinic hallway
- Types of Limp
  - Painful gait: Antalgic gait
  - Waddling gait = abductors weak in both legs
  - Toe to heel gait (plantar flexion) = Equinus gait
- Management
  - Generalization regarding management cannot be made
  - Treatment of the cause



Condition	Age in years			
	0	5	10	15
Septic arthritis	[Red bar from 0 to ~8]			
Trauma	[Red bar from ~12 to 15]			
Osteomyelitis	[Red bar from 0 to ~6]			
Toxic synovitis	[Red bar from ~2 to ~8]			
Perthes disease	[Red bar from ~5 to ~10]			
Slipped epiphysis	[Red bar from ~10 to 15]			
Sarcoma	[Red bar from ~10 to 15]			
Hip dysplasia	[Red bar from 0 to ~5]			
Anisomelia	[Red bar from 0 to 15]			
Cerebral palsy	[Red bar from 0 to 15]			

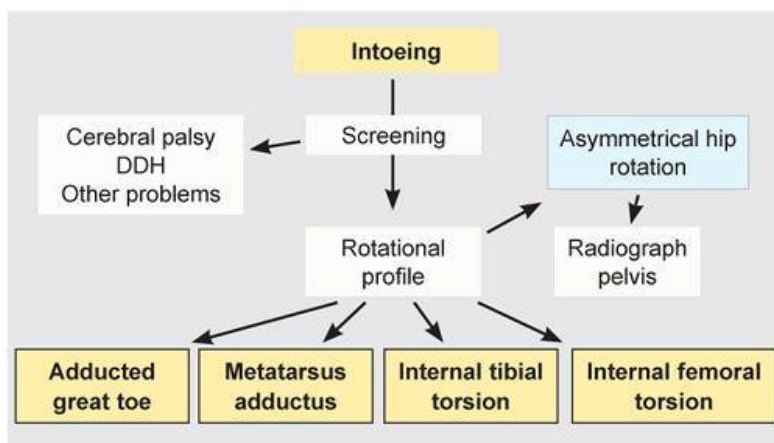


## 2 TORSIONAL DEFORMITIES

- Version
  - Describes normal variations of limb rotation – it may be exaggerated
- Torsion
  - Describes abnormal limb rotation
  - Internal or external
  - It may be complex, if there is compensatory torsion
- Normally: ext. rotation  $>50^\circ$ , int. rotation  $>45^\circ$
- Differentiate between hip, tibia, foot causes
- Determine cause acc. to site

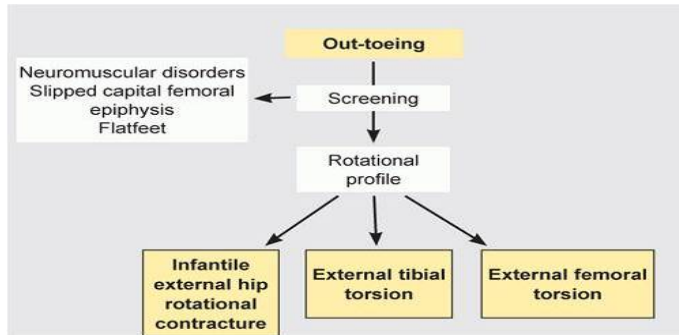
### 2.1 IN-TOEING

- Walking with toe inwards
- MCC of in-toeing is cerebral palsy and DDH
- Increased internal rotation: -W position, cannot sit cross-legged (ext. rot.)  $>$ To assess angle (int. or ext.), look at hip



## 2.2 OUT-TOEING

- Walking with toe everted
- MCC of out-toeing is SCFE and Neuromuscular disorders
- Rt. Foot is directed towards Lt. sacroiliac joint > means tibia is externally rotated (same goes to opp. Side)
- Increased External Rotation

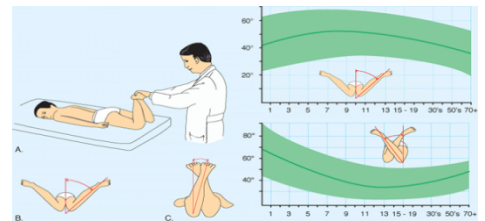


## 2.3 SPECIAL TESTS

- Just understand the concept (Dr didn't emphasize much on them)

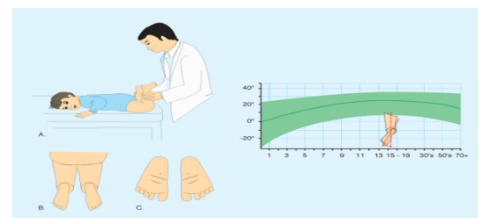
### Assessing hip rotation

- ER in children is normally >50°, whereas IR is 45°
- In intoed child > IR could reach up to 90°



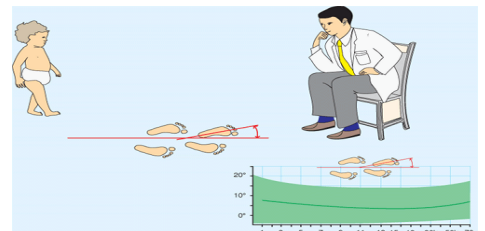
### Assessing rotational status

- Flexion of the knee while the pt is prone
- Then determine bimanual angle of axis or simply look to which side is the foot directed to
- Rt. foot should face the Lt. sacroiliac joint; same goes to the Lt. foot
- If its facing anything else, you can determine if its Int. Tibial Torsion (ITT) or Ext. Tibial Torsion (ETT)
- Ex: If its facing the same SIJ > its ITT
- If the foot is going inwards that means the tibia is going outwards
- Forefoot adduction > determined by looking
- It's important to know the site of the problem in order to know the cause



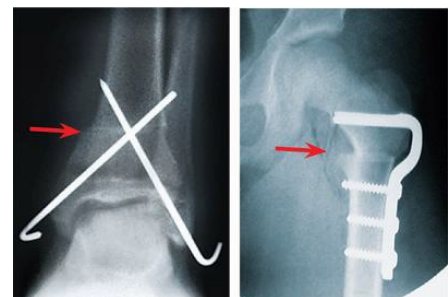
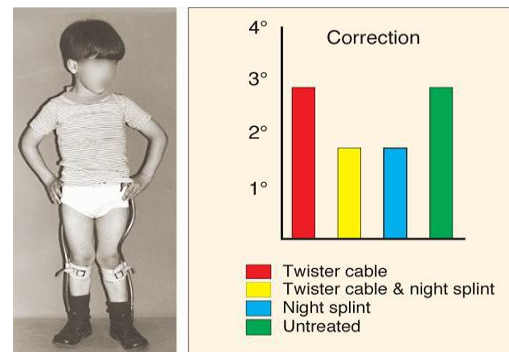
### Foot propagation angle

- Footprints while walking straight > check foot's direction
- Normally foot is 15°everted
- If direct > there's IR
- If more everted > ER



## 2.4 MANAGEMENT

- Determine site to determine the cause
- Define severity to determine Rx accordingly
- Allow for spontaneous correction (observational management) until 8 years of age
- Controlling a child's walking, sitting or sleeping is extremely difficult and frustrating
- Shoe wedges or inserts are ineffective
- Bracing with twister cables limits child's activities
- Night splints have no long term benefit
- If mild > wait for spont. correction
- If severe/past the age of spont. Corr. > surgical:
  - Rotate the bone after doing osteotomy and fix it in place with K-wires for 6-7 wks then remove them
- But if v. severe > can be done earlier than 8 years of age
- Operative correction
  - Indicated for children above the age of 8 years with significant cosmetic and functional deformity
  - Foot: correction of muscle imbalance that has caused the inward or outward deviation of foot
  - Break the bone & rotate it the other direction
  - Ex: 40°intoeing (in hip or femur) > osteotomy of the bone under trochanteric area & then rotate the femur 40°& fixate it using k-wires for 6-7 weeks



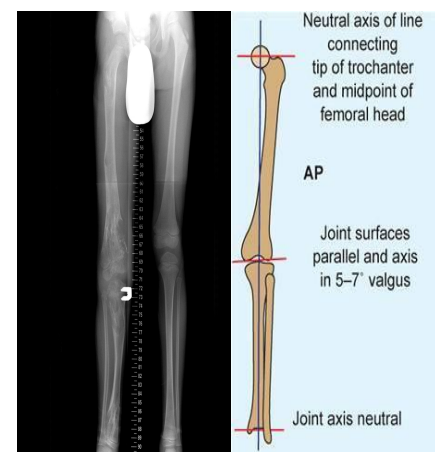
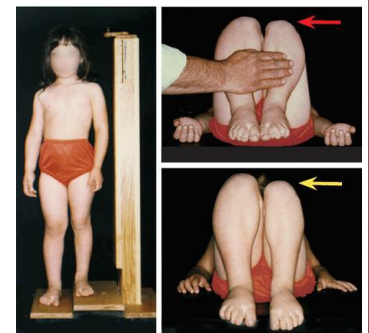
## 3 LIMB LENGTH INEQUALITY

- True: Medial malleolus to superior anterior iliac spine
- Apparent: Medial malleolus to umbilicus
- Etiology
  - Congenital
    - Proximal focal femoral discrepancy
    - Congenital short femur
  - Developmental
    - DDH
    - SCFE
  - Traumatic
    - Trauma will cause overlap or fracture near epiphysis > initiation of bone growth > lengthening > discrepancy
  - Infection
    - By irritation/suppression of epiphysis or initiation to more bone growth

Category	Short	Long
Congenital	Aplasia Hypoplasia Hip dysplasia Clubfoot	Hyperplasia
Neurogenic	Paralysis Disuse	Sympathectomy
Vascular	Ischemia Perthes disease	AV fistular
Infection	Physeal injury	Stimulation
Tumors	Physeal involvement	Vascular lesions
Trauma	Physeal injury Malunion	Fracture stimulation Distraction



- Metabolic
- Tumor
- Adverse effects
  - Gait disturbance
  - Equinus deformity
    - Shortening in Rt. Side, child will involuntarily start to plantar flex the foot (walk on tiptoes) to compensate for the affected movement > with time, PF will become fixed > FPF = equinus deformity (needs surgical intervention)
  - Back pain
    - Due to stress of the inequality
  - Scoliosis
    - Longstanding inequality and stress on the spine will lead to fixation of the spine in that position > scoliosis
- Evaluation
  - Screening examination
  - Clinical measures of discrepancy
    - Pelvis is tilted towards the shortened limb
      - That may be the normal limb, if it was a lengthening case of the other limb
    - Fix the tilt by making the child stand on a wooden block until the pelvis is leveled. The difference b/w the 2 limbs will be equal to the length of the blocks that were put
    - Galeazzi Test: Flexion of hip & knee > check if the knees are at the same level or not. If different, it's LLD.
      - If one knee is lower than the other knee & not deviated to the front > femoral problem
      - If lower than other knee (or at same level) and deviated to the front > tibial problem
  - Imaging methods
    - Centigram, a type of xray, is one of the most imp. methods of determining LLD. A long film of the 2 limbs from hip to toes is taken, while a ruler is put in the x-ray to measure the difference b/w the 2 limbs in length & to locate where the difference is (femur/tibia)
      - This confirms the clinical suspicions
      - It's v. imp to choose the appropriate choice of management
- Management principles
  - Severity
    - LLD < 2 cm:
      - Observe
      - Normal compensation that is found in most ppl



- Not really apparent clinically
- **LLD 2-5 cm:**
  - Shoe lift (for the whole foot NOT only heel)
- **LLD > 5 cm:**
  - Consider surgery or active treatment
- Lifts(as we said, used in MILD cases)
- Shortening
  - Osteotomy then fixation (remove part of bone according to length required)
  - Ex: In neurofibromatosis, there is overgrowth of the whole limb >Debulking of soft tissue + shortening to equalize both limbs
- Epiphysiodesis
  - Temporary Epiphys. is done when you want to do shortening in young children that still have growth potential
  - Clips are inserted both medially and laterally of the bone for a certain period until desired equalization of the limb is achieved. Then have them removed so both limbs can continue to grow normally together at the same pace
  - Permanent method is done for children that are close to skeletal maturity (12-13 y/o). They'll have around 4-5 cms of growth potential left to reach, which equals the length desired to shorten the limb
    - Insertion of screw will destroy the epiphysis > bone stops growing
- Lengthening (just understand the concept)
  - More common
  - We use circular frames or do partial osteotomies& then insert a device that will start to lengthen bit by bit 1 mm per day (or so), by having the patient manipulate a screw of the external apparatus > callous formation b/w the 2 fragments of bone that are lengthening
  - Could reach up to 8 cm in tibia and 15 cm in femur
  - Takes up to 2-3 months. Success rate is high.
  - Can be performed in any age group, easier in children though



## 4 GENU VARUS & GENU VALGUS

### 4.1 DEFINITION

- Valgus: Away from center (distal in relation to proximal) = knock knees
- Varus: Towards center = bow legs

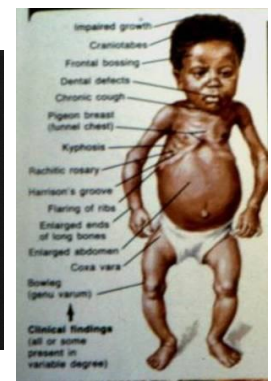


- Could be physiological (more common) or pathological
- Most children go through both varus and valgus:
  - < 2 y/o: physiological Genu Varus
  - >2 y/o: physiological Genu Valgus
  - ~4 y/o: straightening

Feature	Physiologic	Pathologic
Frequency	Common	Rare
Family history	Usually negative	May occur in family
Diet	Normal	May be abnormal
Health	Good	Other MS abnormalities
Onset	Second year for bowing Third year knock-knees	Out of normal sequence Often progressive
Effect of growth	Follows normal pattern	Variable
Height	Normal	Less than 5th percentile
Symmetry	Symmetrical	Symmetrical or asym
Severity	Mild to moderate	Often beyond $\pm 2$ SD

-The normal 5-7° valgus is b/w the axis of the femur and that of the tibia. It's a result of the neck of the femur which doesn't descend straight like the tibia

-Its NOT the same as the mechanical axis which is measured starting from the center of the hip & is normally 0°



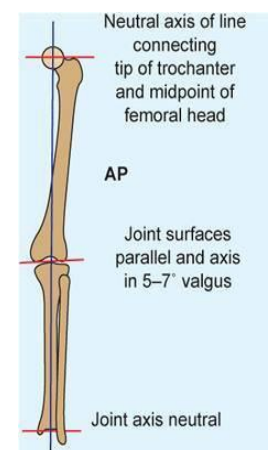
- Always exclude pathological causes first before reassuring parents & treat the underlying cause

## 4.2 EVALUATION

- History
- Examination (signs of Rickets)
  - Rickets is the MCC pathologically
  - If the pt still has active rickets, you don't touch the pt > Postpone the surgery
  - **Residual deformity of Rickets > Osteotomy**
- Investigations
- If physiological > reassure the parents
- Centigram without ruler

Cause	Genu Valgum	Genu Varum
Congenital	Fibular hemimelia	Tibial hemimelia
Dysplasia	Osteochondrodysplasias	Osteochondrodysplasias
Developmental	Knock-knee >2 SD	Bowing >2 SD Tibia vara
Trauma	Overgrowth Partial physeal arrest	Partial physeal arrest
Metabolic	Rickets	Rickets
Osteopenic	Osteogenesis imperfecta	
Infection	Growth plate injury	Growth plate injury
Arthritis	Rheumatoid arthritis knee	

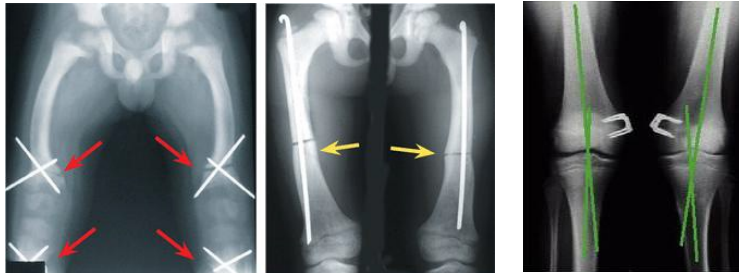
- Take the whole limb under xray to determine the mechanical axis of the limb – the line that passes through the center of all 3 joints in a straight line (Normal = straight)
- Any deviation is an abnormality: Varus = knee outside line , Valgus = knee inside line





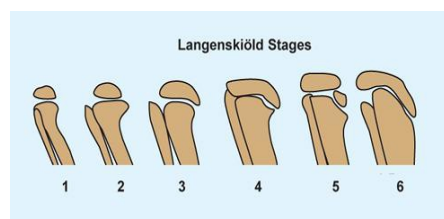
### 4.3 MANAGEMENT

- It's important to determine severity and assess angulation
- If severe > **Corrective osteotomy** (tibia & femur together)
- If mild > **Epiphysiodesis**: Insert clip on medial side of bone to stop it from growing and allowing the lateral side to continue growing (very successful and minor)
  - If Epiphysiodesis is used for severe cases, it could lead to rotational deformities or complete destruction of epiphysis



### 4.4 TIBIA VARA (BLOUNT DISEASE)

- A special entity of Genu Varus
- The etiology is idiopathic
- The pathology is due to damage of proximal medial tibial growth plate
- **Lateral grows more than medial > bowing of legs (varus)**
- It's confined to the tibia (hence its name) and has many stages (1-5)
- **MRI is mandatory**: Bcz that's how we determine the extent of destruction that the epiphysis has underwent
- **Most commonly occurs in blacks and obese**
- Rx:
  - Mostly surgical (except type 1 & sometimes type 2)
  - **Corrective osteotomy**
  - Failure could still occur because of the epiphyseal destruction
  - Unfortunately, lots of times dropping of the tibial plateau occurs after surgery





## 5 FOOT DEFORMITIES

- Let's look at the characteristics of a normal foot first
  - Stable:** for supporting the body weight in standing
  - Resilient:** for walking and running
  - Mobile:** to accommodate variations of surface
  - Cosmetic**

### 5.1 CLUBFOOT (IMP)

#### 5.1.1 ETIOLOGY

- Postural
  - Abnormal posture of uterus (IUGR) causing this deformity >assessed after delivery
- Idiopathic (CTEV)
  - Congenital TalipesEquinoVarus
- Secondary
  - (Spina bifida [MCC], myelodysplasia, arthrogryposis)



#### 5.1.2 DIAGNOSIS

- Diagnosis by exclusion
  - If deformity is identified after delivery, try to do correction manually
    - If corrected successfully > Postural
    - If not > Idiopathic or secondary
      - If there's no syndrome or underlying pathology > Idiopathic
- Differentiate by exclusion (DDx):
  - Neurological lesion that can cause the deformity "Spina Bifida" (excluded by spine x-rays)
  - Other abnormalities that can explain the deformity: "Arthrogryposis, Myelodysplasia"
  - Presence of concomitant congenital anomalies: "Proximal femoral focal deficiency"
  - Syndromic clubfoot: "Larsen's syndrome, Amniotic band Syndrome"

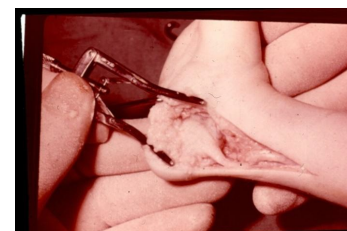
### 5.1.3 CLINICAL EXAMINATION OF IDIOPATHIC

- Characteristic deformity (a MUST in every case)
  - Hind foot:
    - **Equinus**(fixed plantar flexion of ankle joint - FPF)
    - **Varus**(inversion of subtalar joint)
  - Fore foot
    - **Forefoot Adduction**(of talus)
    - **Cavus**(high-arched foot)
- Additional findings
  - Short Achilles tendon(due to FPF)
  - High and small heel (due to FPF)
  - No creases behind Heel(due to FPF)
  - Abnormal crease in middle of the foot(due to forefoot add.)
  - Affected foot is smaller (obvious if unilateral)
  - Callosities at abnormal pressure areas
  - Internal torsion of the leg: **Varusforefoot add. > internal tibial torsion**
  - Calf muscles wasting
  - Deformities don't prevent walking



### 5.1.4 MANAGEMENT

- Aim of treatment:
  - To reach an antigrade, mobile, normal, painless foot which looks cosmetically acceptable and fits normal shoes
- Ponseti technique:
  - Age limit is up to 12 months (controversial, won't be asked about it)
- Manipulation is maintained by a plaster cast
  - It's changed periodically, weekly at 1st, then every 2 wks> until full correction is obtained (4-6 casts)
- Then maintain correction by Dennis Brown splints until pt starts to walk
- Success rate is very high
- Indications for Surgery
  - If pt presents late after 12 months of age
  - Failure of conservative management
  - Complementary to conservative treatment
  - Recurrence of deformity
    - For the 3 above, it could be soft tissue only or ST +/- bone surgery > To regain **function**
  - Complementary surgery (salvage) > To regain **appearance**
    - **Longstanding varus>osteotomy: wedge removed of calcaneus**



- Short Achilles tendon > Lengthening
- Before and after correction slide
- Triple osteotomy (talus – calcaneous – navicular)
  - Most common salvage procedure
  - Loss of inversion or eversion. Pt will feel pain walking on uneven ground, otherwise, they will walk normally

## 6 CEREBRAL PALSY

Cerebral palsy (CP) is a broad term used to describe a group of chronic "palsies" -- disorders that impair control of movement -- due to damage to the developing brain.

### 6.1 PHYSIOLOGICAL CLASSIFICATION

- Spastic
  - Spastic is the MC that goes to surgery
- Athetosis
- Ataxia
  - In ataxia and athetosis> surgery is contraindicated
- Rigidity
- Mixed

### 6.2 TOPOGRAPHIC CLASSIFICATION

- Monoplegia>one limb affected
- Paraplegia>both legs and trunk affected
- Hemiplegia>one side of the body (arm&leg) affected
- Triplegia>three limbs affected
- Quadriplegia or tetraplegia>all four limbs (+/- trunk, tongue and windpipe) affected
- Bilateral hemiplegia
- Diplegia>both legs affected

### 6.3 ASSESSMENT

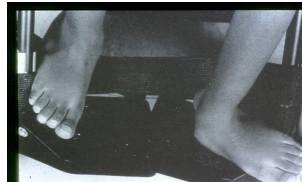
- Hip:
  - Flexion
    - Do Thomas test to assess fixed flexed deformity of hip
  - Adduction: Scissoring gait
    - Hip ROM
  - IR: Intoeing
    - Hip ROM
- Knee:
  - Flexion



- Popliteal angle: Flex hip then extend knee > normally angle of knee extension is 0°. If not, we subtract the measured angle on examination from 180°. That will give us the popliteal angle.



- Ankle
  - Equinus
    - Ankle ROM
  - Varus/Valgus
    - Podoscope
- Gait
  - Intoeing
  - Scissoring



## 6.4 MANAGEMENT

- Management is multidisciplinary
- Options of surgery
  - Neurectomy
  - Tenotomy
  - Tenoplasty
  - Muscle lengthening
  - Tendon Transfer > rarely done
  - Bony surgery Osteotomy/Fusion > for longstanding deformities

