Lecture 12

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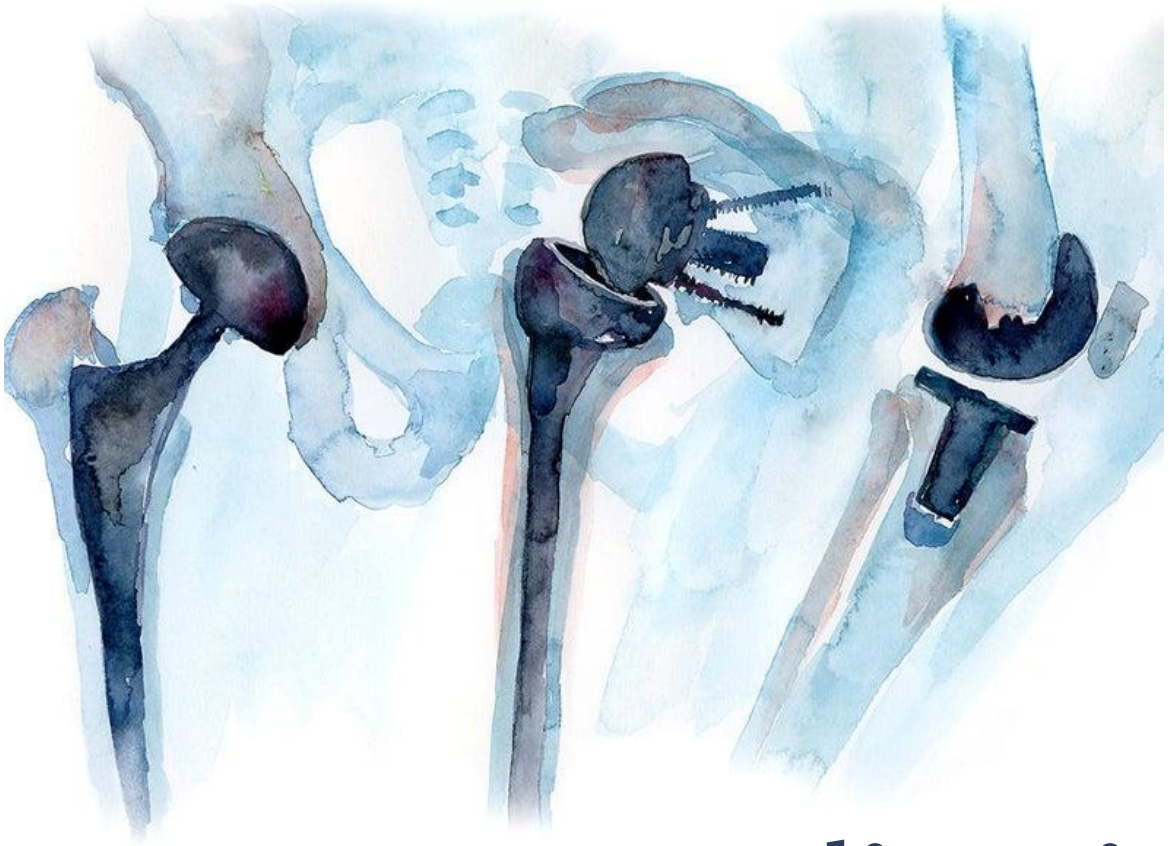


Common Pediatric Lower Limb Disorders

Dr. Khalid Bakarman

Objectives:

- Leg Aches, limping and Leg Length Discrepancy (LLD)
- Intoeing and Outeing
- Physiological and pathological genu valgum and genu varus
- Common pediatric lower limb disorders examples (proximal tibial vara, clubfoot, cerebral palsy)

Color Index:

Original text | Doctor's notes | Text book
Important | Golden notes | Extra

Leg Aches:

What are leg aches?

- Growing pain at age 2-12 years
- Benign with unknown cause
- **Does not cause** any functional disability or limping
- In 15-30% of normal children
- Females more than males
- Resolves spontaneously

Clinical Features

Leg aches is diagnosed by exclusion through history and screening examination

History

- Dull aching poorly localized pain
- Can be with or without activity
- At long bones of the lower limb (usually bilateral)
- At night (end of the day)
- Responds well to analgesia

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

Clinical Findings

- Long bone tenderness (non-specific affecting a large area)
  - ➔ leg aches usually don't have tenderness
- Normal joint motion

Differentials

It is **crucial to exclude serious problems** mainly tumors, common tumors that might cause leg aches are:

- Osteoid osteoma [1]
- Osteosarcoma [1]
- Ewing sarcoma
- Leukemia
- Sickle cell anemia
- Subacute osteomyelitis

Management

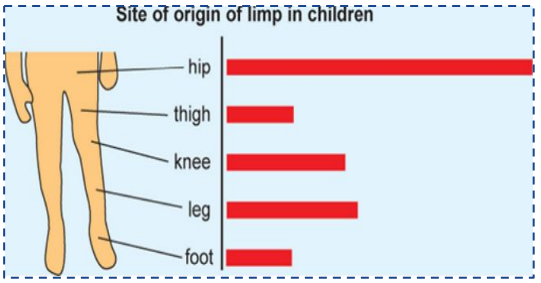
- Reassurance
- Symptomatic: analgesics, massage and bed rest

1- Usually present with night pain, limping, pathological fractures along side with the constitutional symptoms (B symptoms)

Limp:

What is limping?

- Limping is used to describe an abnormal gait [1] due to pain, weakness or deformity.
- Most commonly caused by hip problems followed by leg problems



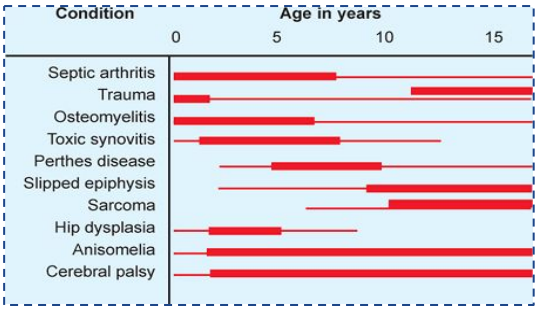
Diagnosis

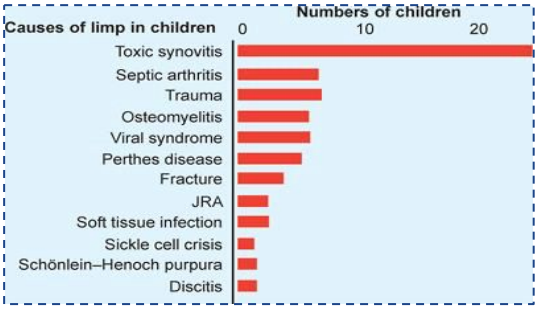
History

- You need to take detailed history specifically the age of onset
- Painful or painless?
  - ➔ Painful is usually unilateral and is caused by trauma, tumors or infections
  - ➔ Painless is usually bilateral and is caused by neuromuscular diseases or congenital

Examination

- You should have a good gait analysis (to determine the site)
  - ➔ Is it above the pelvis? (Back → scoliosis)
  - ➔ Is it below the pelvis? (Hips, knees, ankles and feet)
- Full Neurovascular examination

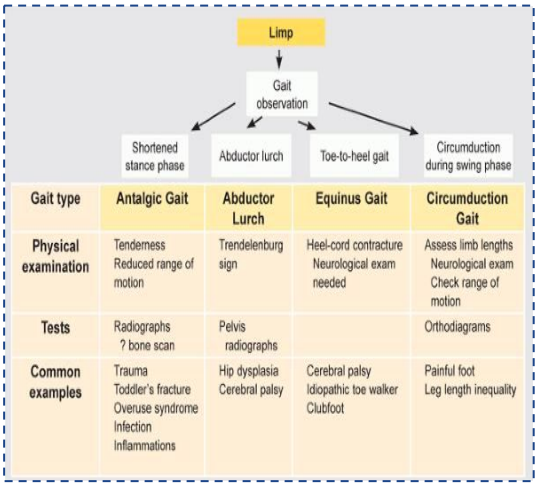




Types of Limps

(Click on the gait)

- We can divide the gait into painful gait (antalgic) and painless gait
- **Antalgic gait:** Abnormal pattern of walking due to pain that results in reduction in the stance phase. **(trauma, tumor, infection)**
- **Abductor Lurch** (AKA trendelenburg gait): Abnormal gait caused by weakness of the hip abductor muscles, leading to contralateral drooping of the pelvis while walking.
- **Equinus Gait:** Seen in children with cerebral palsy, calf spasticity leads to predominant plantar flexion of the ankle joint.
- **Circumduction gait:** Patients with a circumduction gait are unable to achieve adequate clearance for the foot to move through the swing phase on the affected side. To compensate, the patient abducts the thigh and swings the leg in a semi-circle to attain adequate clearance.



Gait type	Antalgic Gait	Abductor Lurch	Equinus Gait	Circumduction Gait
Physical examination	Tenderness Reduced range of motion	Trendelenburg sign	Heel-cord contracture Neurological exam needed	Assess limb lengths Neurological exam Check range of motion
Tests	Radiographs ? bone scan	Pelvis radiographs		Orthodiagrams
Common examples	Trauma Toddler's fracture Overuse syndrome Infection Inflammations	Hip dysplasia Cerebral palsy	Cerebral palsy Idiopathic toe walker Clubfoot	Painful foot Leg length inequality

Management

- Generalization cannot be made.
- Treatment of the cause

1- The normal gait cycle has two phases:
- The stance phase: the phase during which the foot remains in contact with the ground.
- The swing phase: the phase during which the foot is not in contact with the ground.

In-toeing and Out-toeing:

Terminologies

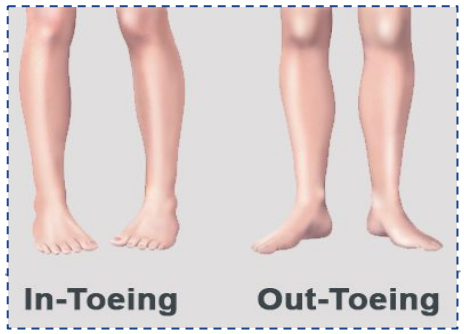
There are two words we need to differentiate from each other:

1. Version: is the normal variation of limb rotations
2. Torsion: describes the abnormal limb rotation (internal/ external)
   - ➔ It may be complex if there is compensatory torsion

- When a fetus is developing in the womb, the lower limbs initially point outward, then begin rotating inward around the seventh week. However, this rotation causes the toes to point towards each other. During the rest of fetal development, the legs gradually rotate laterally again. This lateral rotational growth continues slightly during childhood, but by the time of birth, the feet are approximately pointed straight forward. A small amount of rotation in infant legs is considered within the range of normal growth variation and is referred to as **version**. An abnormal amount of rotation is termed **torsion**.

Evaluation

- We usually start with:
  1. History
  2. Screening examination
  3. Rotational profile



History

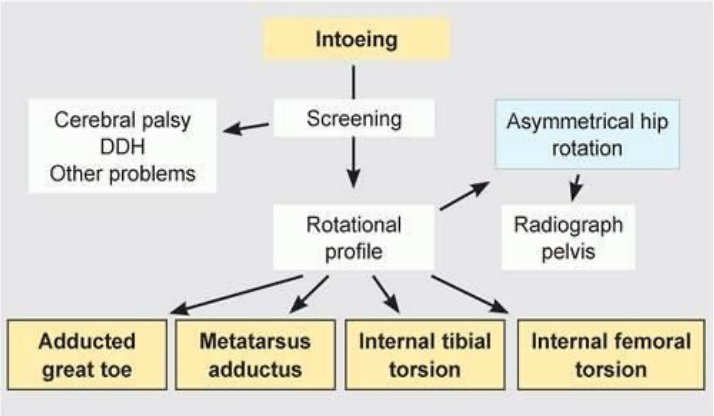
- Onset definitely not seen in 2-3 months old, it occurs after the child walks for few months
- Who noticed it?
- Progression (it is developmental deformity)
- Frequent falling, especially when they run
  - ➔ The main characteristic is that they fall a lot and when they run they fall even more b/c they can't control the rotational profile of their lower limbs.
- Runs with an "Egg-Beater" legs
- Sits in a "W" position
- Family history
- Unilateral vs. bilateral

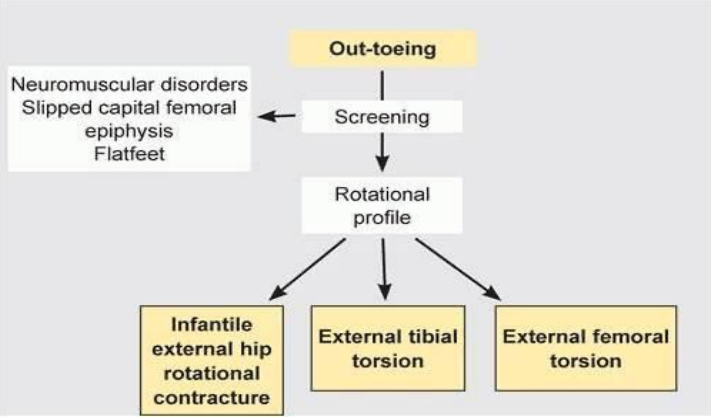
Screening

- We need to screen those patients from head to toe
- These conditions might be associated with neurological disorders such as spina bifida and cerebral palsy.

The figure on the right shows what is known as "W-shaped sitting", a sign to look for when examining such patients.

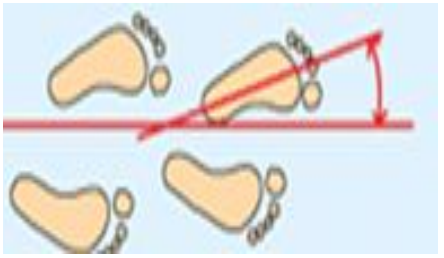
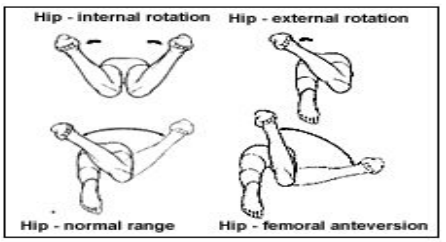
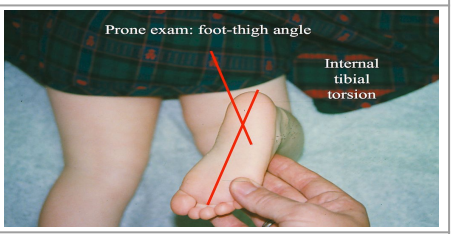
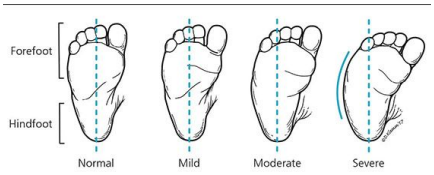
In-toeing and Out-toeing:





Rotational Profile

An assessment known as the rotational profile (also called the torsional profile) which involves taking six different measurements of the angles of the feet, legs, and hips when the child is in various positions and when walking or running. This allows for detection of isolated abnormal angles and facilitates identification of the cause of the rotational problem.

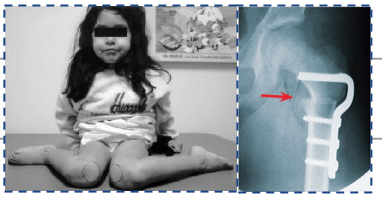
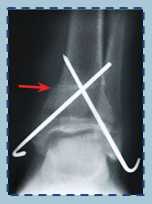
Rotational Profile		
Test	**Description**	**Image**
Foot propagation angle	Represents the angular difference between the axis of the foot with the direction in which the child is walking. **Normal range:** -10° to +15° → -ve = in-toeing → +ve = out-toeing[1]	
Hip rotation profile	Done for **femoral anteversion**, shows how much internal (N = 40-45°) & external (N = 45-50°) rotation can be done at the hip joint.	
Thigh-foot angle	Tests for **tibial torsion.** **Normal range:** 0 to -10°	
Heel bisector line	Tests for **forefoot adduction** (metatarsus adductus) Normal along 2nd toe	

1- Let me be clear, we (the team) are absolutely not sure about the direction of the angle (Is the +ve considered outwards or inwards?), different sources provided different info, we asked the doctor but we got no response, so it's on you, the reader, you're our only hope. We believe in you, ask the doctor, do your own research, find the correct answer, for all of our sakes.

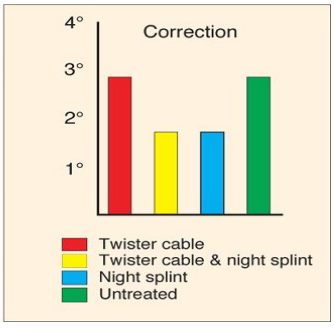
In-toeing and Out-toeing:

Management

- Establish correct diagnosis
- Parents education
- Allow spontaneous correction
- Control child's walking, sitting or sleeping is extremely difficult and frustrating
- Shoe wedges are ineffective
- Bracing with twister cables limits child's activities
- Night splints have no long-term benefits

Common Causes of Intoeing		
Femoral Anteversion (In-toeing)	Description	• Femoral Anteversion is a common congenital condition caused by intrauterine positioning which lead to increased anteversion of the femoral neck relative to the femur with compensatory internal rotation of the femur. 
	Profile	• Increased hip IR with decreased hip ER
	Treatment	• Reassurance and sitting cross legged • Surgery: subtrochanteric osteotomy (over 8y + significant deformity)
Internal Tibial Torsion (In-toeing) 	Description	• Internal Tibial Torsion is a common condition in children less than age 4 which typically presents with internal rotation of the tibia and an in-toeing gait.
	Profile	• Diagnosis is made clinically with a thigh-foot angle > 10 degrees of internal rotation in a patient with an in-toeing gait.
	Treatment	• Spontaneous improvement by age 4 • Surgery: supramalleolar osteotomy (over 8y + significant deformity)
Forefoot Adduction (In-toeing)	Description	• Medial deviation of the forefoot with normal hindfoot
	Profile	• Abnormal heel bisector
	Treatment	• Anteversion shoes (if older try physiotherapy)
Adducted Big Toe (In-toeing)	Description	• occurs in children after walking age and presents with varus deformity of the big toe
	Treatment	• Spontaneous improvement

Causes of Intoeing	
Condition	Key findings
Metatarsus Adductus	Medial deviation of the forefoot (abnormal heel bisector), normal hindfoot
Tibial Torsion	Thigh-foot angle > 10 degrees internal
Femoral Anteversion	Internal rotation >70 degrees and < 20 degrees of external rotation



Limb Length discrepancy (LLD):

Definition

An inequality in leg length can be either true or only apparent.

- True LLD: there us an actual difference between the length of either the femur or tibia
  Example: disruption of the growth plate due to trauma
- Apparent LLD: is attributed to something other than the lengths of the femur or tibia
  Example: scoliosis, knee hyperextension, pelvic muscles imbalance

Etiology

There are many causes of LLD, some are:

- Congenital as DDH
- Developmental as Blount's (Proximal Tibia Vara)
- Traumatic
- Infection
- Metabolic as Rickets
- Tumors
- Vascular lesions as ischemia or perthes
- Neurogenic as paralysis

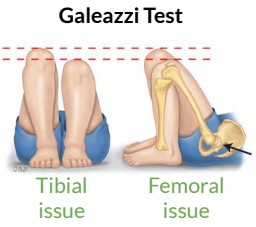
Category	Short	Long
Congenital	Aplasia Hypoplasia Hip dysplasia Clubfoot	Hyperplasia
Neurogenic	Paralysis Disuse	Sympathectomy
Vascular	Ischemia Perthes disease	AV fistular
Infection	Physeal injury	Stimulation
Tumors	Physeal involvement	Vascular lesions
Trauma	Physeal injury Malunion	Fracture stimulation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

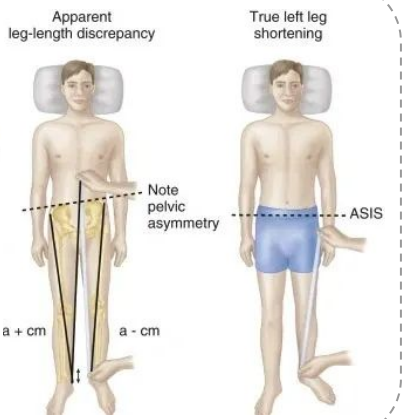
Clinical Picture

- Gait disturbance trendelenburg (if bilateral = waddling gait)
- Equinus deformity
  - ➔ Shortening of one side will case an involuntary plantar flexion on the same side (it might become fixed it's persistent)
- Back and leg pain (due to unequal pressure on limbs)
- Secondary scoliosis

Evaluation

- Screening examination (block testing)
- Clinical measures of discrepancy
  - ➔ True: from ASIS to medial malleolus (MM)
  - ➔ Apparent: from umbilicus to MM
- Galeazzi test
- Imaging methods (centigram/scanogram)
  - ➔ A type of x-ray or CT methods of determining LLD. A long film of the 2 limbs from hip to toes is taken, while a ruler is placed in the x-ray to measure the difference between the 2 limbs in length.





Management

Never operate if it is less than 2 cm

For shorter limb

- Shoe raise (< 2 cm)
- Bone lengthening (> 5 cm)
- Ilizarov principle (1 mm /day)

For longer limb

- Epiphysiodesis/ growth plate arrest (2-5 cm)
- Bone shortening (max 2 cm)

Genu Varum & Genu Valgum:

Definition

- Genu varus (bow legs) or genu valgum (knocked knees) are different alignments of the bones at the knee joints.
- These alignments might be either physiological or pathological depending on the age of presentation

Physiological Presentation

★ Genu varum: birth - 2 years
★ Genu valgum: 2 - 5 years
★ Legs should start to become straight by the age of 5 - 7 years

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 ±2 SD

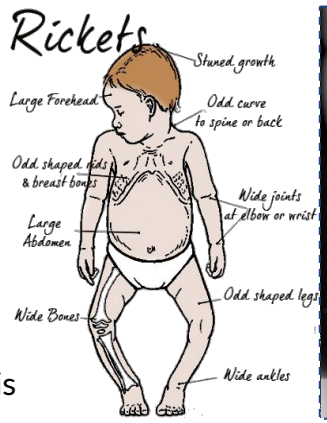
Etiology

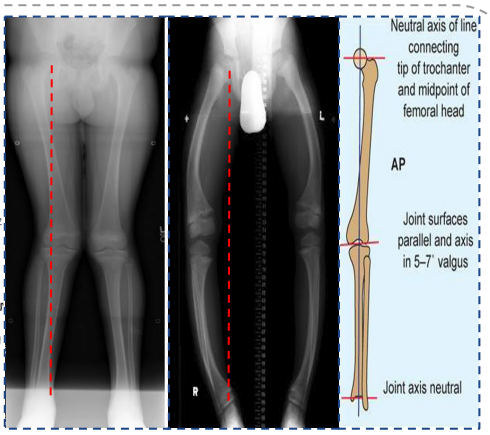
- So, if a child presented with genu varum or valgus different from his physiological alignment at his age, we should investigate him for pathological causes as shown on the table on the right.
- Example: a 3 year old child presented with genu varus, bluish sclera, progressive hearing loss and a history of fractures. X ray showed generalized osteopenia and genu varus. Diagnosis: osteogenesis imperfecta

Cause	Genu Valgum	Genu Varum
Congenital	Fibular hemimelia	Tibial hemimelia
Dysplasia	Osteochondrodysplasias	Osteochondro-dysplasias
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	

Evaluation

- Detailed history
- Examination
  - ➔ Signs of rickets
- Lab
  - ➔ To exclude metabolic causes
- Imaging
  - ➔ Centigram/ scanogram
  - ➔ Rickets: widend growth plates
- **Complications:** early osteoarthritis

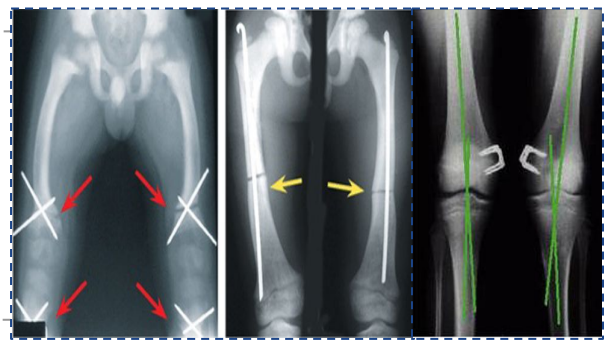




Management

Treat the underlying the cause in pathological and observe in physiological

- Nonoperative
- Epiphysiodesis (temporary vs permanent)
  - ➔ Arrest the growth plate
- Corrective osteotomies (definitive way)



Proximal Tibia Vara (Blount's):

Definition

- Also called blount disease, it is the damage of the proximal medial tibial growth plate (excessive genu varus) due to an **unknown cause**

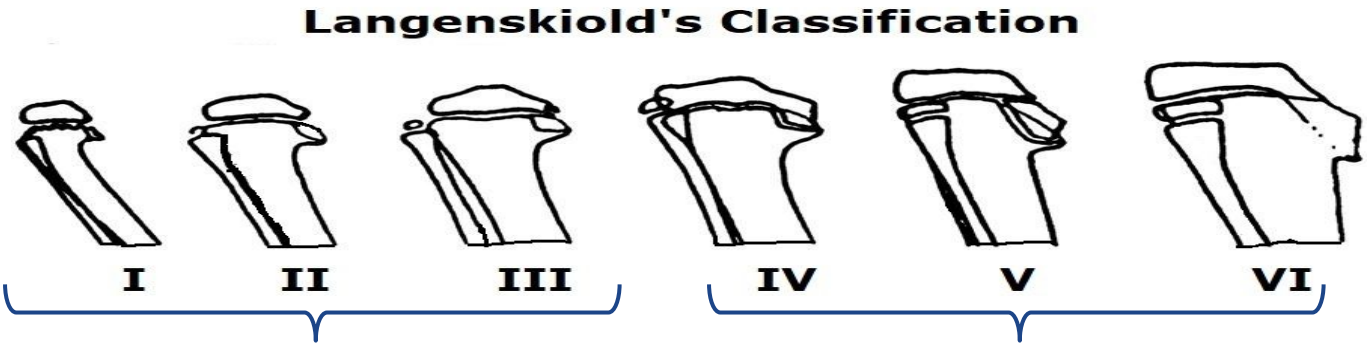
Risk Factors:

- Dark skin
- Overweight

Types:

1. **Infantile**: <3 years usually bilateral and in early walkers
2. **Juvenile**: 3-10 years of age
3. **Adolescent**: >10 years of age, usually unilateral and severe

Classification



Spontaneous improvement

Epiphysis bridges into metaphysis

Evaluation

- In severe or recurrent cases, MRI is mandatory
- On x ray there will be metaphyseal beaking (red arrow)

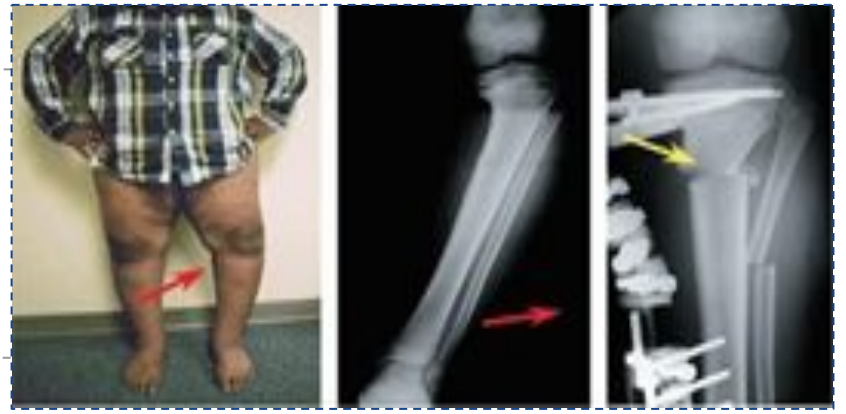
Metaphyseal-diaphyseal angle (Drennan):

- >16° → Abnormal
- 11-16° → Close observation
- <10° → high chance of resolution

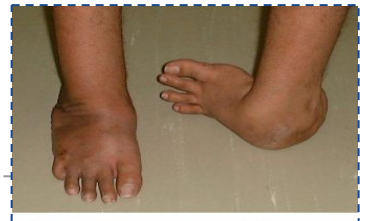
Treatment

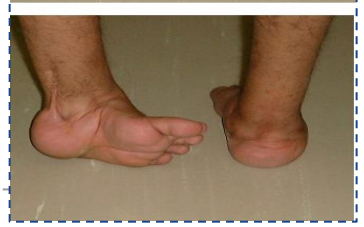
Surgical treatment is the definitive choice

Tibial osteotomy



Clubfoot (Talipes Equinovarus):

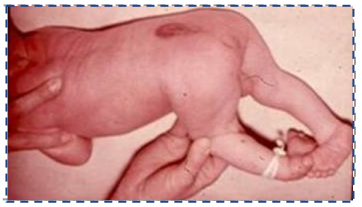




Normal Foot

- **Stable**: for supporting the body weight in standing
- **Resilient**: for walking and running
- **Mobile**: to accommodate variations of surface
- **Cosmetic**

Etiology



- **Postural**: intrauterine positioning (full correctable)
- **Idiopathic**: CTEV
- **Secondary**: Spina bifida, myelomeningocele, MSK diseases

Exclusion

Exclude the following to diagnose CTEV

EXCLUDE

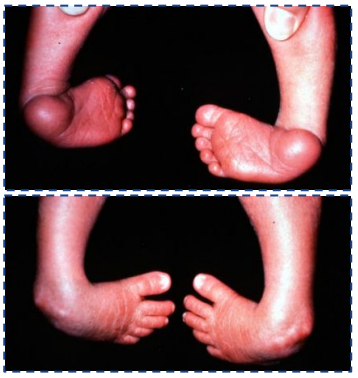
- Neurological lesions such as spina bifida (exclude through an X ray)
- Other abnormalities that explain the deformity such as: Arthrogryposis[1] and myelodysplasia[2]
- Presence of concomitant congenital anomaly such as: proximal femoral focal deficiency[3]
- Syndromatic clubfoot such as Larsen's syndrome[4] and amniotic band syndrome[5]

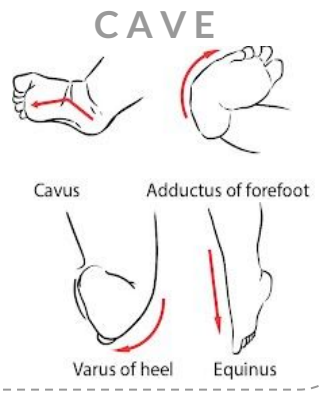
Deformity (CAVE)

Forefoot
- Adduction

Midfoot
- Cavus

Hindfoot
- Equinus: (Ankle joint)
  - Plantar flexion w/ limited dorsiflexion
- Varus: (Subtalar joint)





Clinical Examination

Check image on top right

- Short achilles tendon
- High and small heels
- No creases behind heel
- Abnormal crease in middle of the foot
- Foot is smaller unilaterally
- Callosities at abnormal pressure points
- Internal torsion of the leg
- Calf muscle wasting
- Deformities don't prevent walking

1- Congenital contracture in two or more areas of the body
2- Are a group of cancers in which immature blood cells in the bone marrow do not mature. EquinoVarus is the most common foot deformity in children with Myelodysplasia
3- A rare, non-hereditary birth defect that affects the pelvis, particularly the hip bone, and the proximal femur. The disorder may affect one side or both, with the hip being deformed and the leg shortened.
4- A disorder of the development of the bones. Include clubfoot and numerous joint dislocations at birth with a distinctive appearance of the face & square-shape finger tips
5- A a rare condition caused by strands of the amniotic sac that separate and entangle digits, limbs, or other parts of the fetus.

Clubfoot (Talipes Equinovarus):

Management

- The **goal of treatment** is to obtain a foot that is plantigrade, functional, painless, and stable over time. A cosmetically pleasing appearance is also an important goal sought by surgeon and family

1 Manipulation and Serial Casting

- Cast must be changed weekly for 6-8 weeks
- Valid up to 12 months of age as soft tissue becomes tighter

1. Ponseti Technique

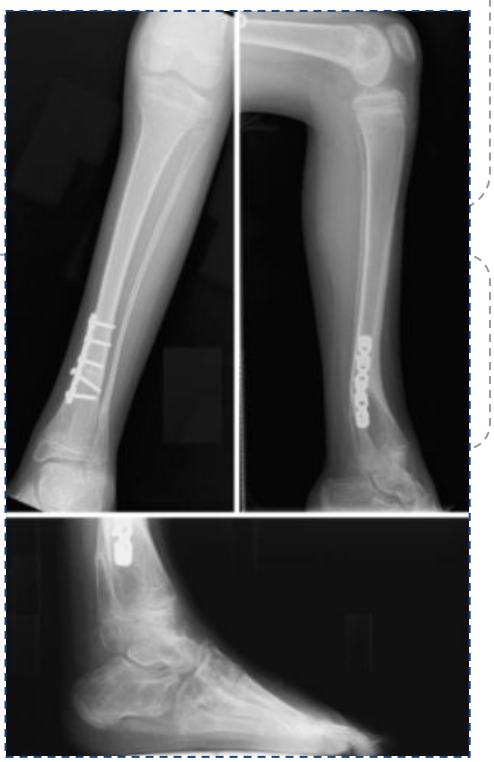
2. Dennis Brown Splint

- Maintain the correction done by the cast (mandatory)
- Paced 23 hrs/day for 3 months then only during sleep for 3-4 years
- Watch and avoid recurrence till 9 years old
- We must stop if the deformity isn't improving or pressure ulcers were formed

2 Surgery

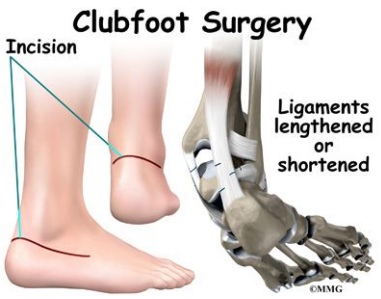
Indications

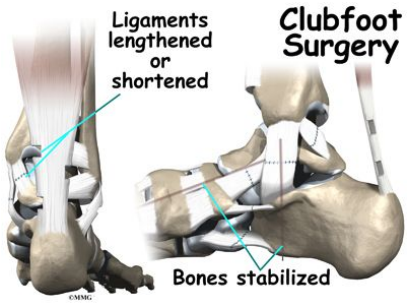
- Late presentation (>12 m)
- Complementary to conservative treatment
- Failure of conservative treatment(>9 m)
- Residual deformities after conservative treatment
- Recurrence after conservative treatment



Types

- Soft tissue [1] (9-12 months)
- Bony [2] (3-4 years)
- Salvage [3] (>10 years)





1- lengthening of soft tissue and tendons
2- Wedge osteotomy: wedge removed of calcaneus
3- If severe and rigid arthrodesis

Cerebral Palsy LL Deformities:

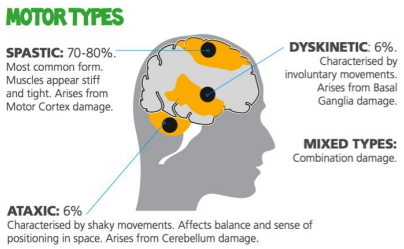
Definition

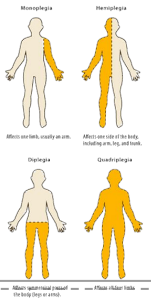
A non-progressive brain insult that occurs during the perinatal period. A deformity might results due to skeletal muscles imbalance that affects joints movement. It might be associated with:

- **Mental retardation**: with variable degrees
- **Hydrocephalus and V.P shunt**
- **Convulsion**

Classification

Physiological Classification	Topographic Classification
• Spastic • Ataxia • Athetosis • Rigidity • Mixed	• Monoplegia (one limb) • Diplegia (two limbs) • Paraplegia (Both lower limbs) • Hemiplegia (One side is affected) • Triplegia (three limbs) • Quadriplegia (All limbs)





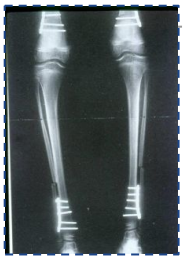
Examination

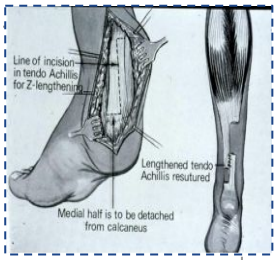
Hip	• Flexion: fixed flexion - Thomas test • Adduction • Internal rotation	**Ankle**	• Equinus • Varus/ valgus • Achilles tendon shortening
Knee	• Flexion: popliteal angle	**Gait**	• In-toeing • Scissoring tight hip adductors • Crouch

Management

Multidisciplinary approach guided by pediatric neurology

- Physiotherapy for ROM and gait training (most integral part)
- Social/ governmental aid
- Orthotic to maintain correction and aid in gait





Indications of surgery

- Severe contractures preventing physiotherapy
- Perineal hygiene (severe hip adduction)
- Help non-walkers sit comfortably
- To prevent neuropathic ulcers and dislocations

Options for Surgery:

1. **Tendon elongation**
2. **Tendon transfer**
3. **Tenotomy**
4. **Neurectomy**
5. **Bone surgery, osteotomy/ fusion**

Quiz

MCQ

Q1: A 7 year old boy came to the clinic complaining of back pain. After examination you noticed one of his legs were shorter than the other. After measuring both limbs the difference in length between them was 1 cm. What is the best form of management for this patient?

A. Bone shortening
B. Bone lengthening
C. Epiphysiodesis
D. Shoe raise

Q2: Which of the following rotational profiles shows a positive result for in-toeing?

A. Heel bisector line: lateral to 3rd toe
B. Foot propagation angle: -17°
C. Thigh-foot angle: 0°
D. Hip internal rotation: 42°

Q3: a 7 month old came to the clinic because his mother noticed his left foot looked abnormal. Further examination showed that he had clubfoot. What is the most appropriate form of management for this patient?

A. Soft tissue surgery
B. Serial casting
C. Dennis brown splint
D. Bone surgery

Q4: what is the most common cause of limping in children?

A. Hip problems
B. Leg problems
C. Thigh problems
D. Knee problems

Q5: sitting in a W position is a common sign in which of the following?

A. Blount's disease
B. LLD
C. Proximal tibial vara
D. In-toeing/out-toeing

SAQs

1. List 3 cause of LLD
   Slide 7
2. An 11 month old child presented with cavus, varus, equinus, and calf muscle wasting. What is the most likely diagnosis?
   Clubfoot
3. Mention the risk factors of blount's disease
   Dark skin and overweight

Answers

Q1	Q2	Q3	Q4	Q5
D	A	B	A	D

THANK YOU

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