9- Common Pediatric Lower Limb Disorders

Objectives:

- In-toeing & out-toeing.
- Genu varus & valgus.
- Proximal tibia vara.
- Club foot.
- Deformities seen in cerebral palsy patients.
- Limping.
- Leg length inequality.
- Leg aches.

Team members: Abdulamalik Alghannam, Fahad Alotaibi, Faisal Alrabuiea, Nouf Aloqaily, Laila Mathkour

Team leader: Mohammed Baqais, Nora AlSahli

Revised by: Abdulaziz Almohammed, Dina Aldossary

References: 435 team, Doctors' notes, 436 slides

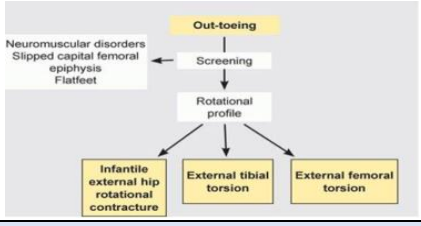
In-toeing and Out-toeing

Terminology:

- Version: normal variations of limb rotation (It may be exaggerated).
- Torsion: abnormal limb rotation (Internal or external).
- It may be complex if there is compensatory torsion.

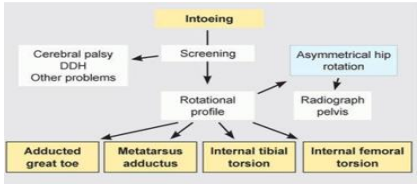
Out toeing It is rare we will not focus on.

- Big toe directed outward.
- Evaluation:
  - History.
  - Screening examination.
  - Rotational profile.



In toeing

- Big toe directed inward
- It's very common, more than you can believe and this is what we will focus on. It runs in families.



History (In-toing)

- Onset, usually after walking age (Age: year to year and half)
- Who noticed it?
- Progression? usually tend to improve from a year to the other
- **Fall a lot?** Usually the main complain is frequent fall. They fall a lot, even when they walk, but more if they run bc they lose control of their lower limbs → more internal rotation →fall they even come with bruises.
- How he/she sits on the ground?
  Ex: "W" shape sitting. زي الضفدع
- Family history.

Examination (In-toing)

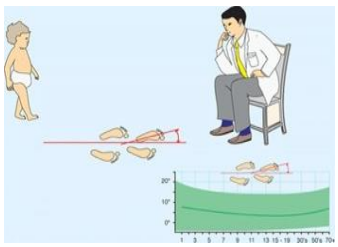
- Screening examination (head to toe).
- **It is a clinical diagnosis not radiological**.

Asses rotational profile: MCQs

- Pathology level → Special test:
  1. **Femoral anteversion** → Hip rotational profile: Supine, Prone.
  2. **Tibial torsion** → Foot thigh axis, Inter-malleolus axis: Supine, Prone.
  3. **Forefoot adduction** → Heel bisector line.
  4. **Wandering big toe.**

- Foot Propagation Angle Normal is (-10°) to (+15°). "- → inward, + → outward"

The doctor set in front of the child and ask him to walk in a straight line drawn in the land



⇒ We don't walk with our feet straight forward, that's not our normal.

⇒ The normal is slight ex-toeing which is up to +15. If the angle beyond 15 this is ex-toeing. Less than -10 degrees is in-toeing.

Treatment (Principles for both)

- Establish correct diagnosis. (You have to make sure it's isolated in-toeing)
- Allow spontaneous correction (observational management).
- Control 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. Doesn't change the outcome
- Night splints have no long term benefit.

In-toeing treatment "Golden Slide" MCQs

- Establish correct diagnosis.
- Parents education as they grow older, they will improve, we rarely operate in them.
- Observation (annual F/U) → Asses degree of improvement. if improved within 2-3 years discharge
    1. **Femoral ante-version** → Reassurance & advise to Sit cross legged.
    2. **Tibial torsion** → Spontaneous improvement.
    3. **Fore foot adduction** → Anti-version shoes, or proper shoes reversal. If older child physiotherapy strengthen peroneii.
    4. **Adducted big toe** → Spontaneous improvement.

#**Operative** correction indicated for children: K-wires

- **(> 8) years** of age with significant cosmetic and functional deformity (<1%)**.**

- Big toe directed inward

- Most common cause of in-toeing: Cerebral palsy, Developmental dysplasia of the hip (DDH).

1- Femoral Anteversion

Normally the neck to the intercondylar is slightly more forward → normal anteversion (10-15 degrees), they have more anteversion.

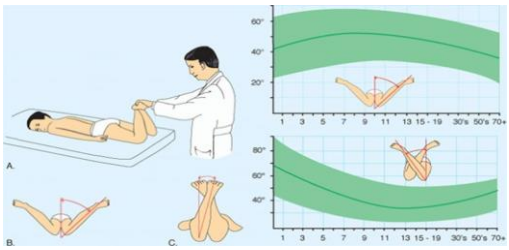
- It's a clinical diagnosis where they have excessive internal rotation of the head of the femur, and little external rotation.
- They easily fell and sitting in W position يجلس ورجلينه جنبه أو جلسة الضفدع. Crossed leg on the ground needs external rotation → **difficult** on them, that's why they like to sit **W shape position.**

✓ Hip rotational profile: Supine

Normal: Internal rotation (IR) **/** External rotation (ER) = 40-45/45-50° "Total 90°"

also called foot progression angle

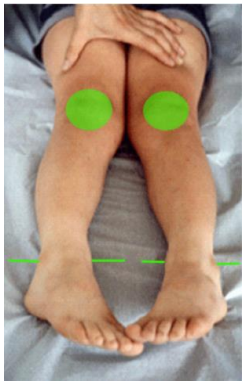
✓ Hip rotational profile: Prone



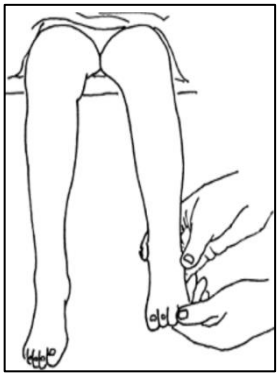
2- Tibial torsion

- ✓ Inter-malleolus axis:

Supine



Sitting



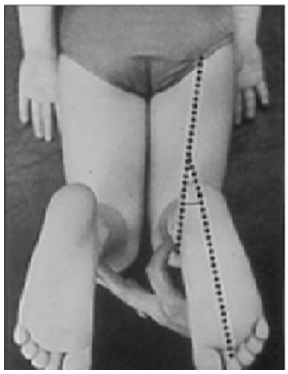
Normally: lateral malleolus is posterior and the medial is anterior.

- If the lateral malleolus was in the same level or more forward to the medial = Internal Tibial torsion.

Lateral malleolus will be directed little bit more anterior indicating **mild** tibial torsion. If it becomes at the level of the medial malleolus "the intermalleolar axis becomes horizontal" indicating **moderate** tibial torsion, or if it becomes even more anterior indicating severe torsion.

- ✓ Foot Thigh axis: (Video)

Normal: (0°) to (-10°)



The physician assesses the angle between the thigh and foot with the knee flexed, don't hold the foot keep it and take our *Goniometer* put the Center on heel and then correct the long axis of the foot and get the long axis of femur and check the angle in between.

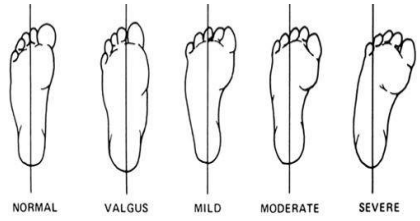
- In-toeing: if the angle decreased caused by internal tibial torsion.
- Out-toeing: if the angle increased caused by external tibial torsion

3- Forefoot adduction

When you come and examine the patient you have to look to the foot from plantar side → kidney shaped foot → then we see is it correctable or not, usually it's fully correctable. نطلع قلم من جيبنا ونحطه بالكعب و يكون مرتاح مو محركها

Normal: along 2 toe Pen axis between the 2nd toe or 2nd web space

- In toeing: if it pass lateral to third toe.
- Out toeing: if it pass medially.



العلاج يا يشتري جزمة مخصصة أو حقته العادية بس يقلب اليمين يسار والعكس. ما ألبسه هالشوز الا لمن يكون المشكلة من الرجل نفسها نبغى جزمة جلدها قوي تدف الرجل مو تكون مرنة و القدم هي اللي تدفها وكمان نقول لهم جزمة للبيت وجزمة للخروج ومو شرط ينام فيها لو ما لبسها مو يعني ما راح يتعدل لكنها تسرّع عملية التعديل ونشوفهم كل سنة، لنفرض إنهم مرّوا الطبيب بعمر 2-3 سنوات لو عالجناهم بهالطريقة و وصلوا عمر 8-9 كم منهم يحتاج تدخل جراحي؟ 1 بالمية فقط! بمعنى إن الطريقة هذي تعتبر فعّالة بهالعمر لكن لو جاء الطفل بعمر ٨ سنوات أو أكثر راح يحتاج علاج طبيعي لتقوية عضلة peronii.

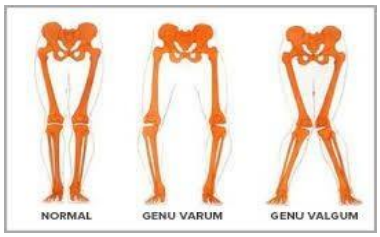
4- Adducted big toe

Anti-version shoes won't correct it.

Genu Varus & Valgus

Kaplan notes high yield osmosis notes

- Bow legs (genu varus). Affect the femur and tibia it's like big C.
- Knock knees (genu valgus).



Normal Genu Varum & Genu Valgum

★ Types: – **Physiological** (usually **Bi**lateral). – **Pathological** (**Uni**lateral)

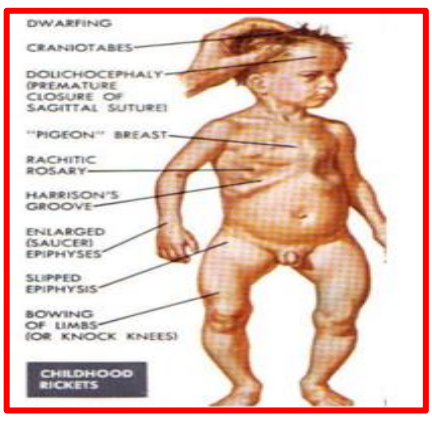
★ Etiologies:

Physiologic	Pathologic
○ Observe and reassure the parents (usually bilateral). The natural history for genu (knee) development: - From born – 2 years: Genu varus - 2-5 years: Genu Valgus. - After 5 years the legs will straight to be normal	○ Trauma. ○ Infection. ○ Tumor. ○ Syndromes. If Bilateral think about Rickets & Congenital.

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

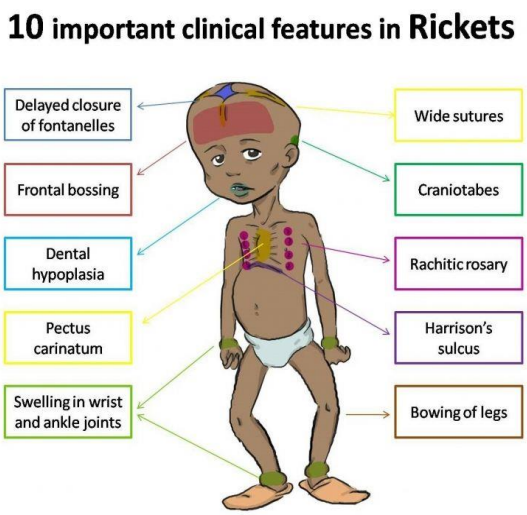
★ Evaluation:

- ○ History (detailed).
- ○ Examination (e.g. Signs of Rickets).
- ○ Laboratory (Ca level and vit.D).
- ○ Imaging: Centigram.



In x-ray of rickets they have all of the growth plates are wide (Widened epiphysis), cupping and fraying of metaphysis. If rickets hit in valgus age the child will have valgus legs, so it depends on what age vitamin D deficiency happened. .ونفس الشيء إذا جاء بوقت الفارز خلاص يستمر معاه فارز

الصورة هذي إكسترا بس **مهم** تعرفون أعراض الريكتز، يجي سيناريو بالإختبار



★ Comolications: **Early Osteoarthritis**, That's why we need to detect it early.

★ Managment: **MCQs**

#Non-operative:

- ✓ Physiological: Observation.
- ✓ Pathological: must treat underlying cause, (e.g. in Rickets give vit D) we never do the surgery until the pediatrician approves that the child is completely treated then we wait for a year or two for body remolding usually no surgery needed the body will be healed.

#Epiphysiodesis: نفس الدباسة تأخر نمو العظام مؤقتا

- **Valgus:** Insert clip on medial side of bone to stop it from growing and allowing the lateral side to continue growing.
- **Varus:** Insert clip on lateral side of bone to stop it from growing and allowing the medial side to continue growing.

#Corrective osteotomies (tibia & femur together)

Proximal TIBIA VARA (BLOUNT DISEASE) Medscape

Damage of proximal medial tibial growth plate of **un**known cause.

Blount disease:

- Suggestive if here is no history of metabolic, tumor, trauma and it is only in one side.
- Genu varum.
- Needs surgery as soon as possible.
- The normal walking age is 12-16 months.

★ Risk factors:

- Overweight.
- Dark skin.

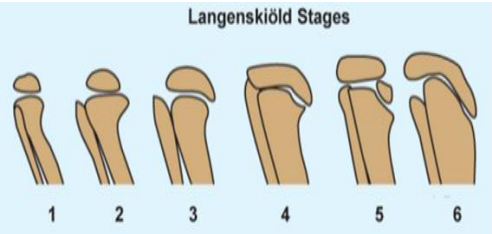
Abnormal growth → زي المنقار

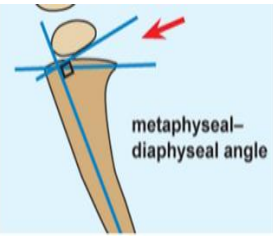
In metaphysis

★ Types:

1. Infantile → **< 3y** of age, usually **Bi**lateral and in early walkers.
2. Juvenile → 3-10y, Combination.
3. Adolescent → **> 10y**, usually **Uni**lateral.

★ Staging:





★ Investigation:

In severe cases, recurrence → **MRI** is mandatory.

★ Treatment:

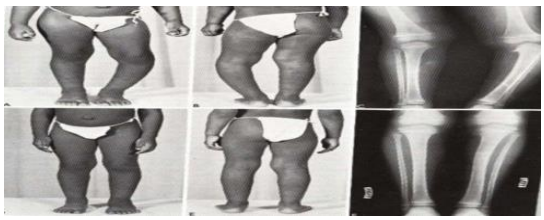
- Mostly **surgical**.
- More late → more damage & High stage → bad prognosis.

We correct it either by using gradual correction with external fixator or acute correction with high tibial osteotomy.

Infantile bilateral → we do high tibial osteotomy.

Unilateral

Bilateral



Club foot

Toronto notes Kaplan notes high yield osmosis notes

نتذكرها بشكل عصا القولف

★ Etiology: "Golden Slide" MCQs

1. Postural: Abnormal postural in the uterus. Fully correctable, needs only intensive **physiotherapy.** For example, if the mother was pregnant with triplets.
2. Idiopathic (CTEV[1]): Partially correctable.
3. Secondary (Spina Bifida): Neurological and muscular problems (Rigid deformity), patient needs workup, and exclude differential diagnosis. Most common cause (Spina Bifida).

★ Diagnosis: by exclusion, exclude:

1. Neurological lesion that can cause the deformity "**Spina Bifida**". (Exclude by spine **x-ray**)
2. Other abnormalities that can explain the deformity "Arthrogryposis[2], Myelodysplasia[3]".

[1] Congenital Talipes EquinoVarus: Club-foot. The term 'talipes' is derived from talus (Latin = ankle bone) and pes (Latin =foot)

[2] Congenital joint contracture in two or more areas of the body.

3. Presence of concomitant congenital anomalies "Proximal femoral focal deficiency[4]".
4. Syndromatic clubfoot: "Larsen's syndrome[5], Amniotic band Syndrome[6]".

★ Characteristic deformity:

- **Hind foot:** (post. ⅓ of foot 'Calcaneus, Ankle, Tibia')
  - ⇒ Equinus: Fixed plantar flexion of ankle Joint (FPF) (Ankle joint, tight A.T "Achilles tendon"). Sever equinus is indication of surgery
  - ⇒ Varus: inversion of subtalar joint (Subtalar joint).

- **Midfoot & Forefoot**: (Mid ⅓ of foot + ant. ⅓)
  - ⇒ Cavus (high-arched foot): (pronation*) *اللي هو مقدار هبوط الرجل مع الحركة
  - ⇒ Forefoot Adduction. (adduction of talus)

★ Clinical examination: Usually presents with pain due to unequal distribution of the weight on the foot.

- Deformities don't prevent walking.
- Calf muscles wasting.
- Callosities (dead skin) at abnormal pressure areas.
- Abnormal crease in middle of the foot. (due to forefoot adduction)
- Affected foot is smaller (obvious if unilateral).
- Internal torsion of the leg.
- Short Achilles tendon. (due to FPF)
- Heel is high and small. (due to FPF)
- No creases behind Heel. (due to FPF)

★ Management:

The goal of treatment is to obtain a foot that is **plantigrade** (straight foot), **functional**, **painless**, and **stable** over time, which looks cosmetically acceptable and fits normal shoes. A **cosmetically** pleasing appearance is also an important goal sought by surgeon and family.

A. Manipulation and **serial casts**:
   - ⇒ **Ponseti technique:**
     - ✓ Change the cast weekly (usually 6-8 weeks).
     - ✓ Validity up to 12 months → soft tissue becomes tighter. The younger they are, the better the result.

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[3] 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.

[4] 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.

[5] 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.

[6] A a rare condition caused by strands of the amniotic sac that separate and entangle digits, limbs, or other parts of the fetus.

⇒ **Dennis Brown splints:**

- ✓ Maintains correction.
- ✓ Up to 3-4 years old.

⇒ **Follow up:** Watch and avoid recurrence, till 9 years old (Foot at age of 9 will be fully developed, after 9 it will only increase in size)

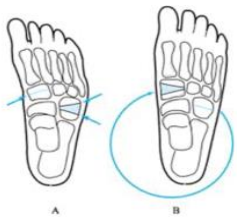
⇒ **Avoid** false correction by going in sequence.

⇒ When to **stop?** Not improving, pressure ulcers.

B. **Indications of surgical treatment:**

1. Late presentation, **after** 12 months of age.
2. Complementary to conservative treatment, as residual forefoot adduction (also**>12m**).
3. Failure of conservative treatment (**>9m** old). after 9 months to prevent growth plate injury and ossification center injury. إذا سويتها قبل بيبصير AVN
4. Recurrence after conservative treatment (**>9m** old). If the child can jump and land on the same foot that means its mobile, its stable, not painful and functional.

⇒ **Types of surgery:**



1. Soft tissue (**9-12 m**onths) 'can b 14 months': Lengthening soft tissues and tendons.
2. Bony (**>3-4 y**ears) 'can be 5 years': Wedge osteotomy: wedge removed of calcaneus.
3. Salvage[7]: If sever & rigid → Arthrodesis (**>10 y**ears)

L.L Deformities in CEREBRAL PALSY (CP)

A non-progressive brain insult that occurred during the peri-natal period.

★ Causes: Skeletal muscles **imbalance** that affects joint's movement. العضلات الفليكسورز تكون أقوى

Can be **associated with:**

- Mental retardation (various degrees).
- Hydrocephalus and V.P shunt.
- Convulsions.

It's not uncommon.

★ Classification (Types): **MCQs**

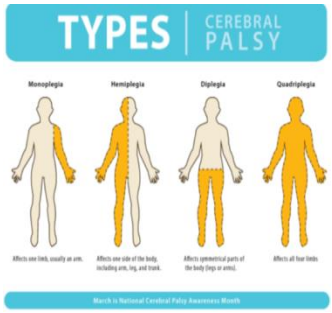
A. Physiological classifications:

1. Spastic. Surgery to fix muscle contracture (commonest & best prognosis).
2. Ataxia. (Surgery contraindicated)
3. Athetosis. Slow, involuntary, convoluted, writhing movements of the fingers, hands, toes, and feet (Surgery contraindicated)
4. Rigidity.
5. Mixed. The worst

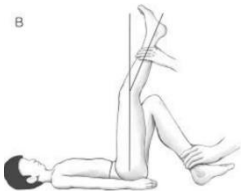
[7] 'rescue', used to refer to **surgical** treatment after failure of initial treatment.

B. Topographic classification:

1. Monoplegia.
2. Diplegia. The commonest (weakness more in lower limbs than in upper limbs)
3. Paraplegia.
4. Hemiplegia.
5. Triplegia.
6. Quadriplegia or tetraplegia.



★ Examination and assessment:

Hip	⇒ Flexion: Do Thomas test to assess fixed flexed deformity of hip. ⇒ Adduction. ⇒ Internal Rotation.	**Knee**	⇒ Flexion: Popliteal angle. 
Ankle	⇒ Equinus. ⇒ Varus/Valgus. ⇒ Achilles tendon shorting. 	**Gait**	⇒ In-toeing (femoral ante-version & tibial torsion) ⇒ Scissoring tight hip adductors ⇒ crouch

#Right hemiplegia classic appearance: Flexed elbow, Flexed wrist, Foot equines.

★ Management: "Golden Slide" MCQs

- **Multidisciplinary** approach:
  - Parents education.
  - Pediatric neurology diagnosis → Follow-up, treat fits.
  - **Physiotherapy** (home & center) → joints R.O.M, gait training. **Number 1** treatment + The most **integral** (essential) part of treatment.
  - Orthotics → maintain correction, aid in gait.
- Social / Government aid. Other:
  - Neurosurgery (V.P shunt).
  - Ophthalmology (eyes sequent).

- **Surgery indications:** MCQs
  - ✓ Severe contractures preventing physiotherapy.
  - ✓ Physiotherapy is plateaued due to contractures.
  - ✓ Perennial hygiene (sever hips adduction). (predispose to fungal infections and dermatitis)
  - ✓ In a non-walker, to sit comfortable in wheelchair.
  - ✓ Prevent:
    - Neuropathic skin ulceration (as feet).
    - Joint dislocation (as hip)

★ Options of Surgery: Neurectomy, Tenotomy, Tendon elongation, Tendon Transfer,

Bony surgery: Osteotomy/Fusion. **Botox** injection used to paralyze the muscle temporary last for 3 months.

Limping

Abnormal gait due to:

- Deformity (bone or joint).
- Weakness (general/nerve/muscle).
- Pain (where). In one or both limbs.

Most common cause is due to hips then legs problems.

⇒ Painful gait: Antalgic gait (usually unilateral):
- Trauma.
- Tumor.
- Infection.

⇒ Painless gait (usually bilateral):
- Syndromic.
- Congenital.

★ Diagnosed by:

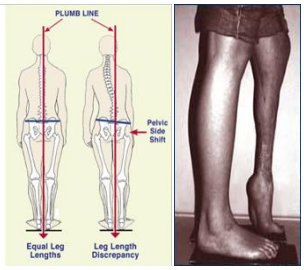
1- History → detailed specially **age** of onset.

2- Examination
○ Gait good analysis. ○ Is it: **- Above pelvis:** Back (scoliosis). **- Below pelvis:** Hips, knees, ankles, & feet. ○ Neurovascular **Trendelenburg gait:** When the hip abductor muscles (gluteusmedius and minimus) are weak, the stabilizing effect of these muscles during gait is lost. (bilateral = waddling gait). **Antalgic gait:** pain with shorting of stance phase. **Trendelenburg test:** ask the patient to stand using his 2 legs, notice the level of the shoulders. Then ask him to stand on one leg, if the patient bend his body/waist to the other side that's mean a positive test. If the patient complain from the knee pain, examine the hip also (referred pain)
3- Management
○ Generalization regarding management cannot be made. ○ Treat the underlying cause.

Limb Length Inequality

★ Etiology:

- Congenital: as DDH.
- Developmental: As Blount's.
- Traumatic: As oblique fracture (short), or multi-fragmented (long).
- Infection: Stunted growth or dissolved part of bone.
- Metabolic: As rickets (unilateral).
- Tumors: Affecting the physis.



★ Clinical features:

- Gait disturbance (tip toe walking or Trendelenburg gait).
- Equinus deformity. ex. Shortening in Rt. Side, child will involuntarily start to plantar flexion the Rt. foot (walk on tip toes) to compensate for The affected movement. With time, PF will become Fixed > cannot do dorsal flexion. Or he will put the left foot down to equalize the legs.
- Pain: back, leg. Child with back pain think about Length Inequality.
- Scoliosis (secondary).

★ Evaluation:

True	Apparent
First, the leg length is **affected** If you measure it: one leg will be shorter, with time this will lead to: pelvic tilt to adjust. Measure **from** ASIS "anterior superior iliac spine" **to** medial malleolus.	The Leg length: will appear asymmetric but if you measure it: they are with the same length. Measure **from** umbilicus **to** medial malleolus.

- **Screening examination** (Clinical measures of discrepancy):
  While the patient **supine**: (Video) If there is pelvic tilt make sure that it's corrected then **by Measuring tape** measure true and apparent leg length.
  While the patient is **standing**: Adding blocks under the short leg until the pelvis becomes elevated.
- Galeazzi Test: (Video) To know where is the defect, is it in tibia or femur.
- **Imaging methods (Centigram)** accurate measure of legs length by X-ray.

★ Management:

Please click here

Depends on the severity: (>2cm)

⇒ **For the shorter limb:**
- Bone Lengthening.
- Shoe raise.

⇒ **For the longer limb:**
- Bone shortening (remove part of bone. usually we don't use it).
- Epiphysiodesis (temporary or permanent) (stop the growth).

Leg aches

It is a growing pain (achy muscle pains at age 2-12 yr), increase with walking.

- Cramping in both legs in 15-30% of normal children.
- Benign.
- No functional disability or limbing.
- Female > Male.
- Resolves spontaneously, over several years.
- Unknown cause.

Common presentation that the child sleeps after massage

★ Clinical features:

Diagnosis by exclusion of other Causes of the pain (Tumor – Trauma – Infection)

History: Pain	Examination:
✓ **Site:** At long bones of Lower limb, usually **bi**lateral. ✓ **Onset:** Of long duration (**months**) & there is no hx of trauma. ✓ **Characteristics:** **Dull** aching pain, poorly or not localized. (suggestive of tumor) ✓ **Relieving factors:** Responds to analgesia. ✓ **Aggravating factors:** Activity (but it can be without any activity). ✓ **Time:** At night. Constitutional symptoms: to exclude malignancy	✓ Long bone tenderness → non-specific for a large area, or none. ✓ Normal joints motion.

★ Differential diagnosis:

- Osteoid osteoma (presented with dull aching pain at night and responds to analgesia)
- Osteosarcoma (constitutional symptoms)
- Ewing sarcoma.
- Leukemia.
- Sickle cell anemia (ask about family history).
- Subacute Osteomyelitis.

Exclude serious problems mainly tumor.

★ Management:

- ✓ **Reassurance.**
- ✓ Symptomatic? Analgesia, Rest, Massage.

★ Remember:

1. Intoeing: is one of 4 causes, treatment depends on the level, mainly observe, operate >8y old.

2. Genu varus & valgus: phys vs. patho, rickets, when operate?

3. Blount: early walkers, treatment mainly surgery.

4. CTEV: 3 types, treat as young as possible, Ponseti better to avoid surgery.

5. L.L in C.P: mainly treat spastic, PT importance, surgery indications.

6. Limping: due (pain- weak- deformed), above or below pelvis.

7. L.L.I: proper assess (cause & level), treated >2cm, options of treat.

8. Leg aches: symptomatic treatment.