10. LIMB LENGTH DISCREPANCY

Causes

1. Congenital: FFD [Focal femoral deficiency]
Tibial or fibular hemimelia
Congenital pseudarthrosis tibia

2. Dysplasia: eg: Ollier's, Fibrous dysplasia

3. Developmental: Slipped femoral epiphysis [SUFE], Perthes', Avascular necrosis and collapse of femoral head

4. Trauma: Growth plate or Malunion

5. Infection

6. Neurological: Polio, Spina bifida

7. Inflammation: Rheumatoid Arthritis

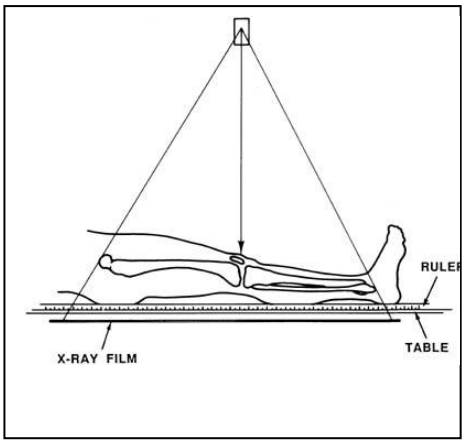
Lengthening is seen in 1) Neurofibromatosis
2) A-V anastomoses
3) Klippel Trenaunay Weber syndrome
4) Russel Silver syndrome
5) Proteus syndrome:
Virulent form of limb hypertrophy
May need amputation

Assessment
Parental heights
Evidence of maturation
Stand: Posture, Walk and gait
Block test, Pelvic obliquity and spine. True length and apparent length
Examination of the spine
Look for vascular abnormalities, Café au lait sports
ROM of the joints
Neurology

COMPENSATION FOR LLD

Scoliosis
Hip flexion/knee flexion
Pelvic tilt
Equinus foot
Vaulting (swinging gait on walking)

Investigation
Long films
CT Scannogram: 6 monthly
Skeletal age: Greulich and Pyle [X ray of the Wrist]



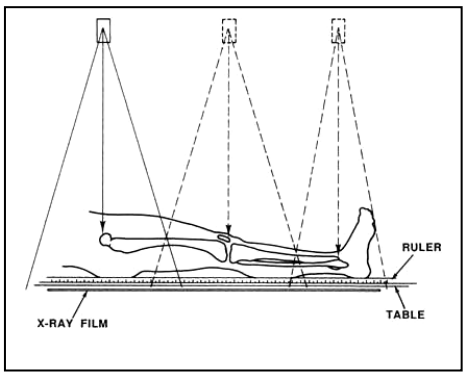
X ray Scannogram

The teleoradiograph is a single-exposure x-ray shot from a 2 m (6 ft) distance with a radiopaque ruler placed on the film cassette.

It can reveal an angular deformity but has the disadvantage of increasing distortion through parallax of the x-ray beam

The ortho radiograph avoids the parallax problem by taking three separate exposures on the same ruled cassette. The ruler must be fixed to the x-ray table

For children younger than 5 or 6 years of age, the teleoradiograph is more appropriate as patient may not stay still.



The Greulich-Pyle atlas

Most commonly used to determine the skeletal age.
The left hand and wrist are imaged in the anteroposterior plane
There are separate standards are used for boys and girls

Prediction of Discrepancy: 4 methods
The arithmetic method
The Eastwood Cole method
The Green-Anderson method
The Moseley straight line graph method.

Menelaus method

Assumptions: 1. Boys stop growing at age 16 yrs and. Girls at 14 yrs

2. Growth: Distal femoral physis grows 10 mm per year
Proximal tibia: 6 mm per year

It is useful only during later years [puberty]

Growth rate peaks during puberty [Boys 13 - 15] and [Girls 11 and 13]

Femoral growth Proximal: 30% Distal: 70% at the knee

Tibial growth Proximal 60% Distal 40% at the ankle

Example: girl aged 11 years		
	Assumptions	Retardation
	Distal femur	1.0 cm
	Proximal tibia	0.6 cm
	Both	1.6 cm
A	Calculate the current discrepancy	2.5 cm
B	Calculate the change in discrepancy per year	0.3 cm
C	Calculate time remaining for growth Girls (14 − current age)	3.0 years
D	Calculate the discrepancy at maturity $A + (B \times C)$	$2.5 + (0.3 \times 3.0) = 3.4$ cm
E	Select an epiphysiodesis that will provide appropriate inhibition.	Both at 2 years before maturity = 3.2 cm
F	Timing of epiphysiodesis	Age 12

Growth ceases: 14 yrs in Girls and 16 in Boys

Treatment

< 2 cm	Shoe raise
2-5 cm	Epiphysiodesis
>5 cm	with no growth left: Lengthening
	Can lengthen about 15% of original length of the bone
	Or Shortening of the normal side

EPIPHYSIODESIS

Requisition: At least 2 years of skeletal growth should be present

12 years in girls and 14 in Boys

Epiphysiodesis Can correct 2-6 cm discrepancy

Technique **Modified Phemister**
Percutaneous, use of Image intensifier and identify growth plate

4.5 drill and sweep the drill anterior and posterior in the growth plate

Do it on two side ie., tibia and femur

Proximal growth plate of fibula [avoid damage to LPN]

Blount Staples
Unpredictable
Could lead to permanent growth arrest
Rebound phenomenon
Stapling is still used in varus/valgus deformity. 20ºAngle can be corrected.

SHORTENING
Tall patient; skeletally matured skeleton
About 5 cm in the femur and 4 cm in the tibia can be corrected
Technique: Step cut metaphysis of the femur
Problem: Quadriceps lag
Knee instability

LENTHENING

Metaphyseal procedure
Delay before distraction: 5 days
Slow distraction (1mm/day)
Ilizarov - Role in Limb lengthening
Indication: Nonunion - Atrophic, Hypertrophic
Pseudarthrosis, infected fractures
Shortening more than 5 cm

Assessment: prior to Ilizarov application
Stiffness in joint above and below
Limb length discrepancy
Deformity at the fracture site
Presence of Infection: Requires debridement

Principle

Distraction osteogenesis
Compression osteogenesis at docking site
Corticotomy: increases blood supply at the Non-union and therefore no need for bone graft
Distraction and compression: Bone transportation and compression at the fracture site

Advantages	**Disadvantages**
High success	Compliance
Minimal invasive	Long duration
Corrects deformity	
Early weight bearing	
Limb lengthening	

Warning signs for Ilizarov
Pain
Paraesthesia
Compartment syndrome
Loss of movement
Hypertension

Technique
1. Corticotomy: no power saw using Giglis saw
2. Tension 130 kg tension on the wire
3. Initial delay of 10 days in children and 14 days in adults and then distract 1 mm / day ie., ¼ turn every 6 hours
4. Weekly X ray to assess callus

Complication
1. Pin track infection: keep clean until scab is formed. Oral or IV antibiotics as required
2. Joint deformity: Equinus. Aggressive physiotherapy
3. Subluxation of the joint: PFD and limb lengthening: subluxation of the knee
4. Deformity of the bone: unilateral frame for femur can cause varus
5. Nerve and vessels
6. Lack of bone formation: ultrasound assessment

12. PHYSEAL ARREST

Femur distal:	common
	Accounts for >50% of growth arrest
	30% with Salter Harris type II [only 7% with type II with distal radius]

Assessment

1. Limb length: Apparent, true and functional
2. Standing long leg films
3. CT Scannogram
4. MRI of the growth plate
5. Any associated deformity

Types

Central [localised and elongated]
Peripheral

Treatment

Epiphysiolysis is indicated when at least 2 years of growth is present
When Physeal bridge is less than 40% of physeal area
.
Additional Osteotomy is required when angulation is more than 20º
Interposition: PMAA or fat
70-80% success