Limb Lengthening in Children
RSS and other etiologies

Pediatric Endocrine Rounds, Weill Cornell Medical Center, January 22, 2013

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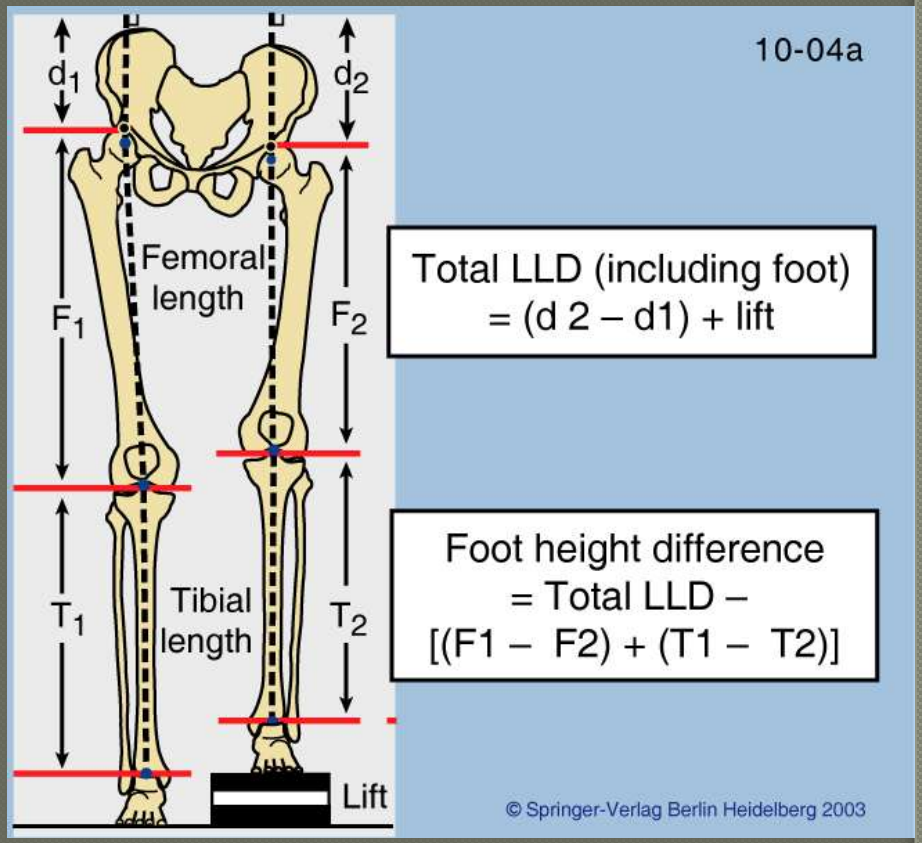
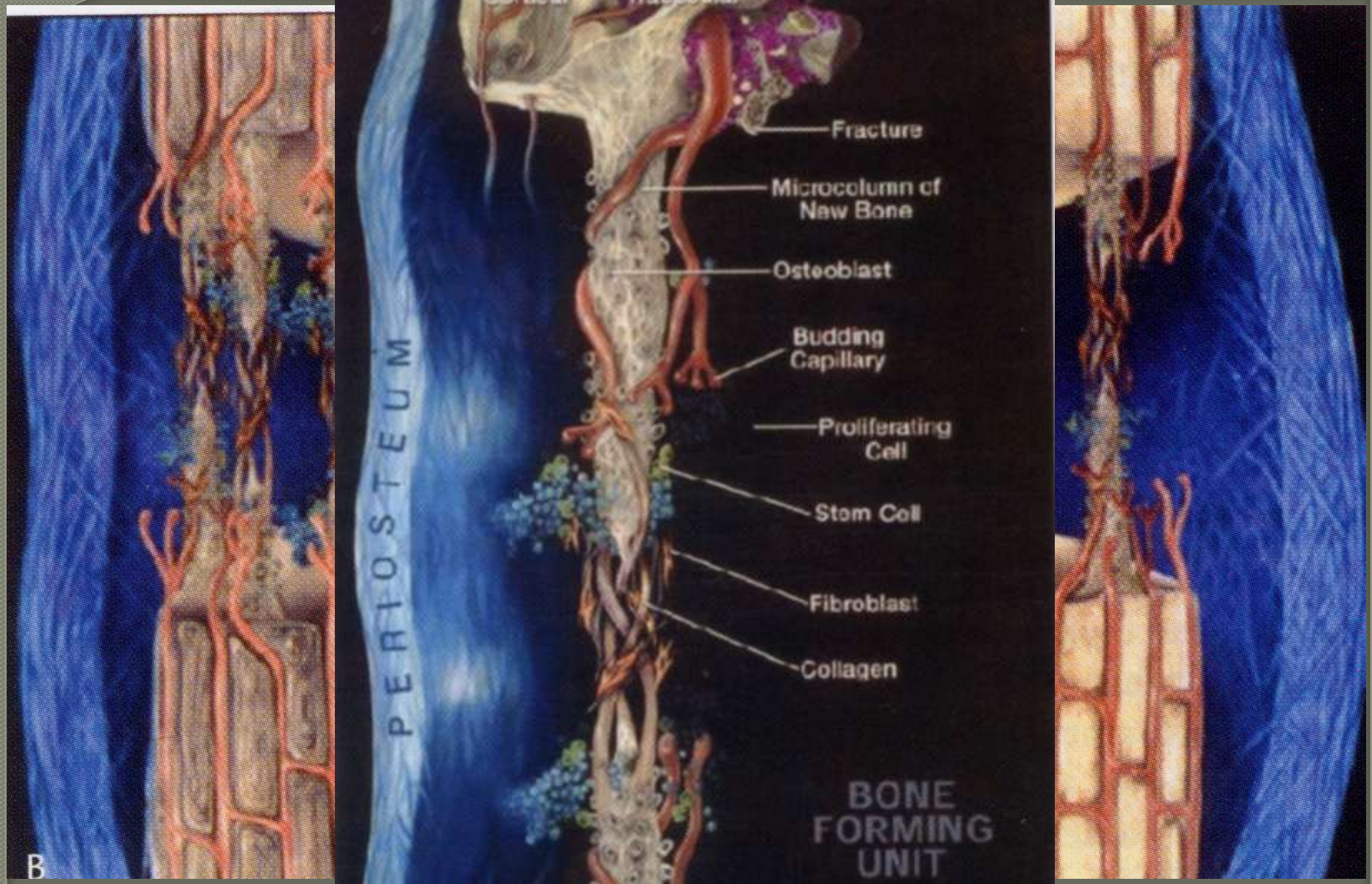
HOSPITAL FOR SPECIAL SURGERY

LIMB LENGTHENING.COM

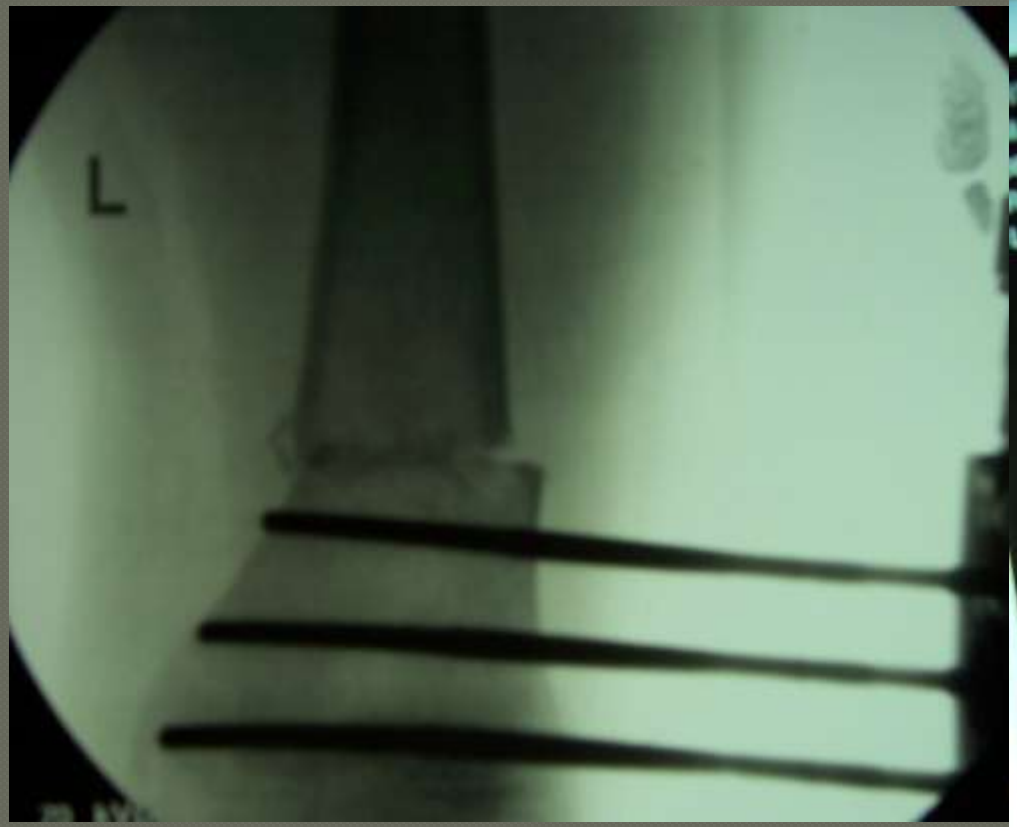
Evaluation

- Causes of LLD
  - Congenital
  - Traumatic Growth arrest
  - Tumor
  - Overgrowth
  - Neural inhibition




Cortical
Trabecular
Fracture
Microcolumn of New Bone
Osteoblast
Budding Capillary
Proliferating Cell
Stem Cell
Fibroblast
Collagen
PERIOSTEUM
BONE FORMING UNIT
DISTRACTION OSTEOGENESIS
A
B

Hemiatrophy
Age 13
LLD 5 cm divided femur/tibia
Valgus deformity
Multiplier 1.12
PLLD = 5x1.12= 5.6 cm

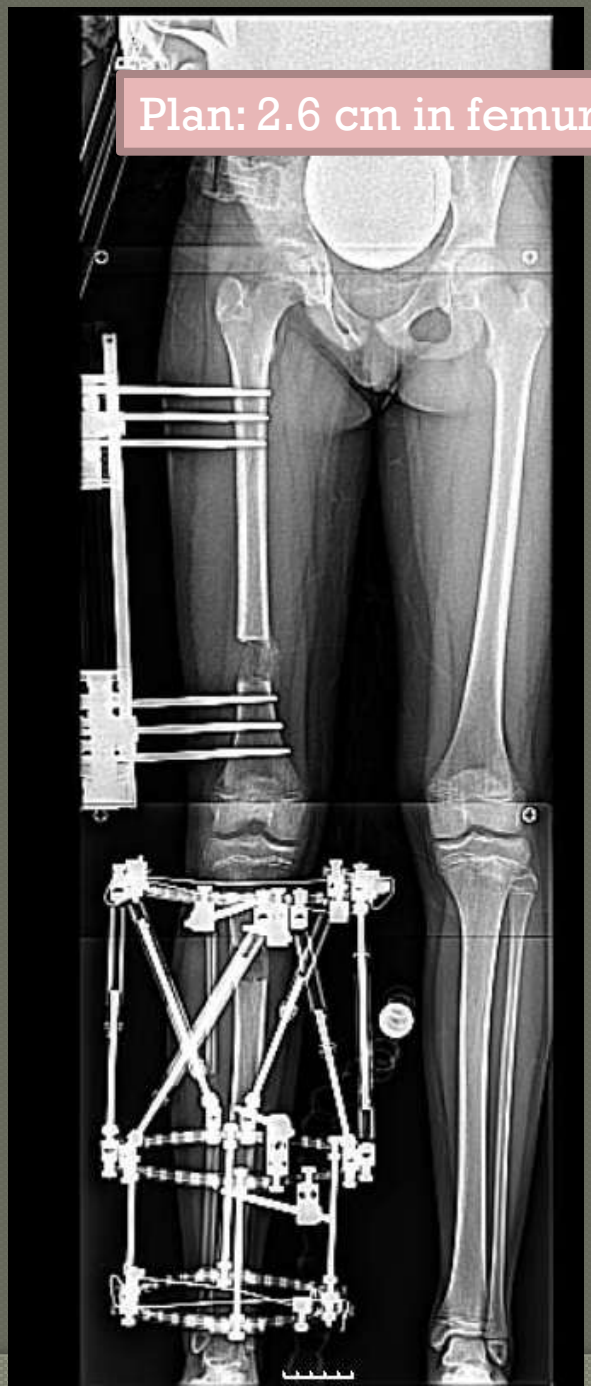


Plan: correct valgus
2.8 cm femur
2.8 cm tibia
Overlengthen by 6 mm

Russell Silver Syndrome

age 13
LLD 5 cm divided femur/tibia
M= 1.03
PLLD= 5.2 cm

Plan: 2.6 cm in femur and tibia




R
JD
e manually calibrated.

RSS, age 8
LLD 4 cm divided femur/tibia
M= 1.33
PLLD= 5.3

Puberty will be delayed and on HGH
PLLD will be greater (6-7 cm)
Lengthen tibia 4 cm to correct LLD
Lengthen femur in future

age 4, valgus deformity
LLD= 4 cm mostly femur
M= 1.83
PLLD= 7.3 cm

Plan: lengthen femur 4 cm
Correct deformity
2nd lengthening in future








Age 8, congenital
LLD 5.5 cm , femur /tibia
M=1.53
PLLD= 8.5 cm

Plan: 4.5 cm lengthening
Of femur
Second future
lengthening
tibia

Limb Lengthening in Children with Silver-Russell Syndrome: A Comparison to Other Etiologies

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Introduction

- Silver-Russell syndrome (SRS) - rare
- IUGR, difficulty feeding, postnatal growth retardation.
- LLD - more than 90% of patients.
- Bone healing following lengthening is a concern (inadequate caloric intake)
- No specific data published about SRS lengthening

Growth hormone (GH)

- Abnormalities of GH secretion have been reported in many SRS children
- Human GH treatment benefits - increased linear growth without concomitant increases in LLD (not limited for SRS patients)
- While hGH therapy increases total limb length it does not appear to induce limb specific catch-up growth or reduce the discrepancy between limbs.
- Given the frequency and severity of the LLD associated with SRS (reported average 3.1 cm) many patients will present for limb equalization surgery; however, epiphysiodesis is not a good option

Research question

- We asked whether pediatric patients with SRS (treated with hGH) will have uniformly good bone healing following leg lengthening.

Methods

- Retrospective comparison
- Study group - SRS patients with LLD - lengthening while on GH
- Control group – general pediatric lengthening patients (congenital, post-traumatic, tumor)

Methods

- 7 limb segments in 5 patients with SRS
- 21 segments in 19 patients – Control

Posttraumatic 8/7

Congenital 9/8

Tumor 4/4

Methods

	SRS	Control	P value
Age (years)	10.4	13	0.036
Lengthening (cm)	3.3	3.9	0.507
Follow up (months)	32 (16-38)	58 (12-130)	

Bone Healing Index

days of bone healing per cm of lengthening

	SRS	Control	P value
Bone Healing Index (BHI), days/cm	29	43	0.028

RSS patients had significantly faster bone healing during limb lengthening

Subgroup comparison of Bone healing Index

	SRS, 29	Trauma, 31.4	Congenital 41.4
Congenital 41.4	P=0.032	P=0.068	
Tumor, 66	P=0.019	P=0.04	P=0.162
Trauma, 31.4	P=0.298		P=0.068

Discussion

Function limiting LLD vs. concern about bone healing.

Scarcity of literature on SRS lengthening

hGH has known positive effect on fracture healing, not well documented for human limb lengthening

- Recent animal studies also showed that GH improved muscle recovery during limb lengthening

Discussion

- All SRS patients had good outcome, no significant problems
- No premature consolidation on hGH
- No hGH-related orthopedic complications (LCP, SCFE, scoliosis)

Conclusion

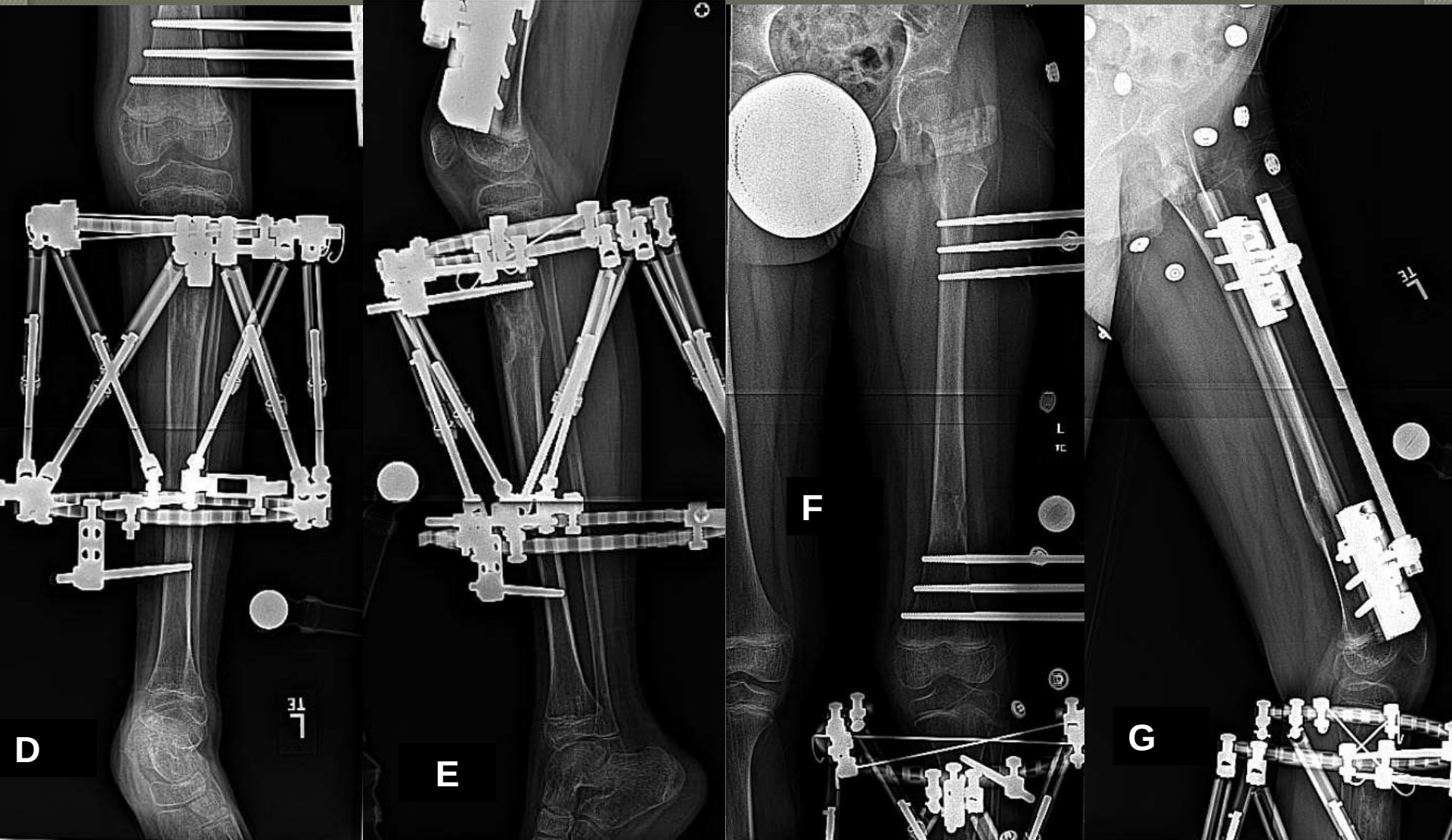
- SRS patients treated with hGH -uniformly good healing of bone regenerate
- SRS BHI is significantly shorter than in a general pediatric population.
- hGH may significantly improve regenerate formation and consolidation

Age 12 yo
LLD 39 D/45 ID mm
Δ F 27 mm
Δ T 18 mm
PLLD ~ 5.3 cm

A


B

C

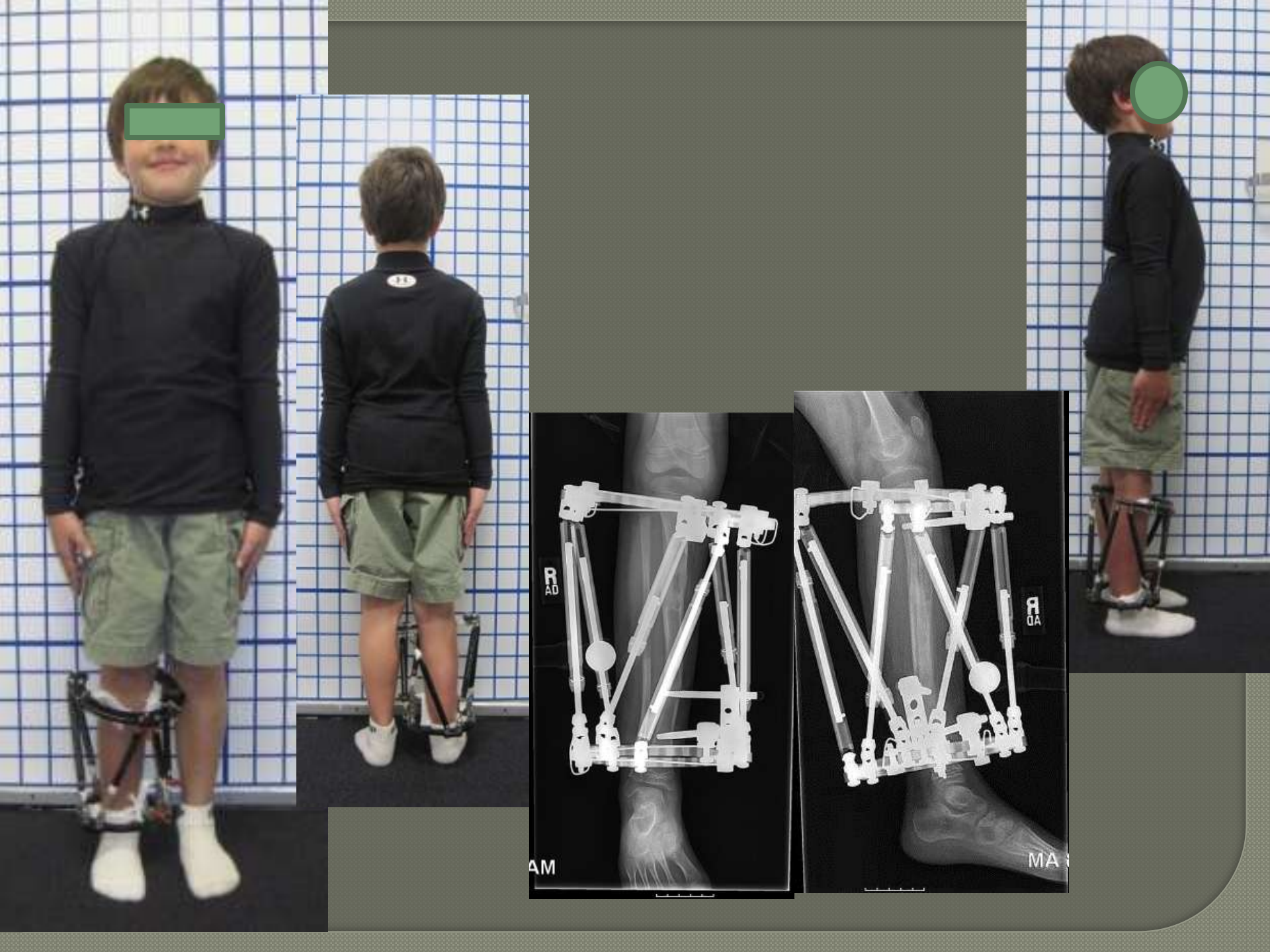

D
E
F
G


H
I


no lift/no shoes

Posteromedial bow, age 6
LLD= 36 mm, all tibia
M= 1.68
PLLD= 6.1 cm

Plan: lengthen tibia 3.6 cm
Correct some prox tibia varus
Second lengthening in future



3 months
In frame


GILLS ROCK
FISH BOIL
DOOR CO.


no lifting shoes
R

Ellis Van Crevald Syndrome

hemiepiphysiodesis


WEST COAST


P
AK no kh/ns shoes

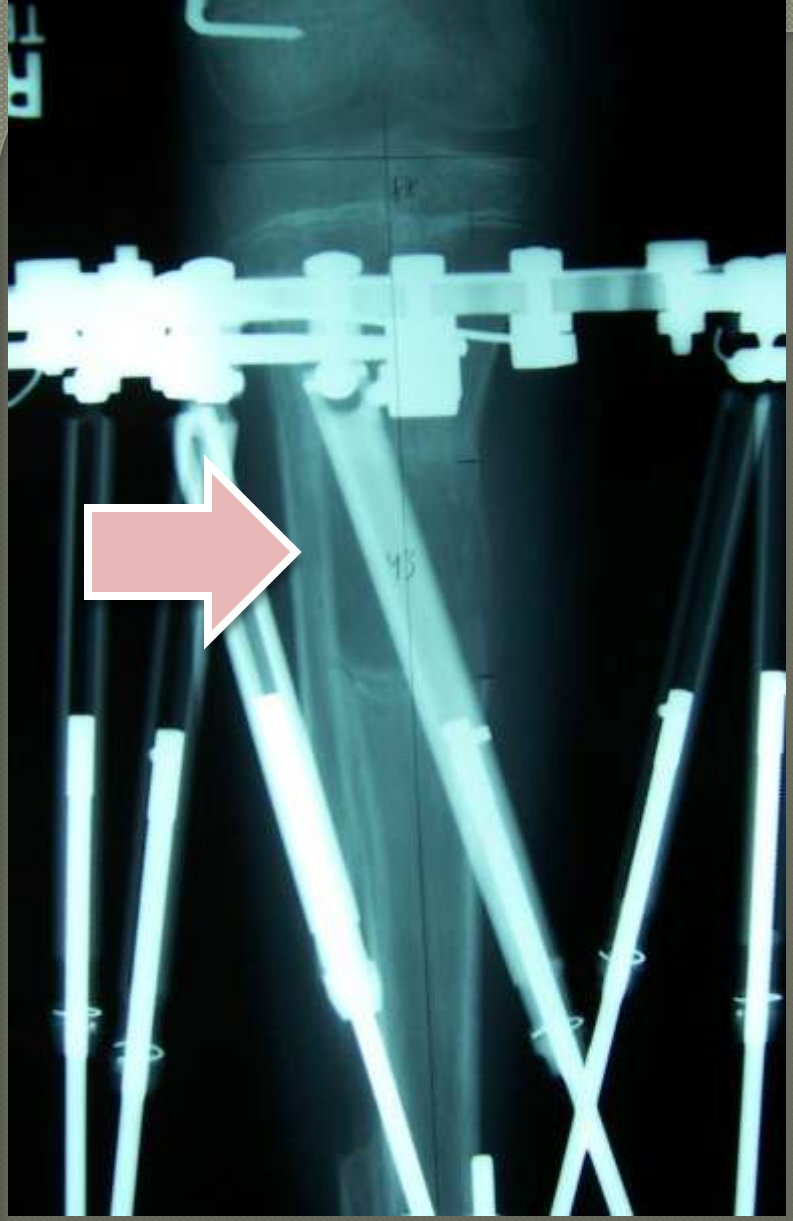
Hypophosphatemic Rickets

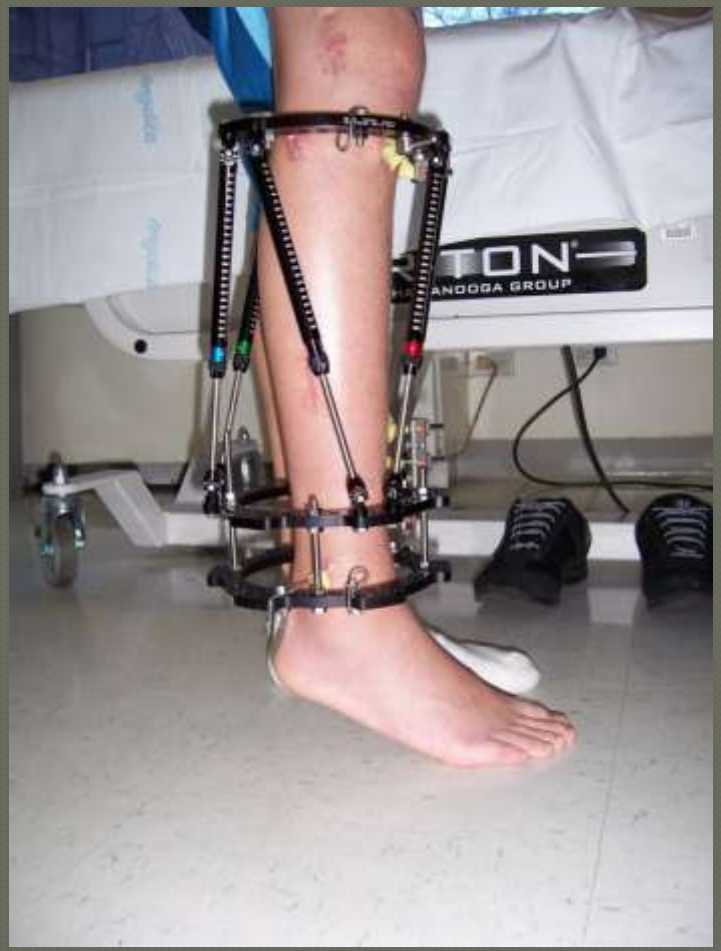
Age 9
5 cm LLD


SPONGEBOB
ATHLETICS


5 cm

Age 12
9 cm LLD



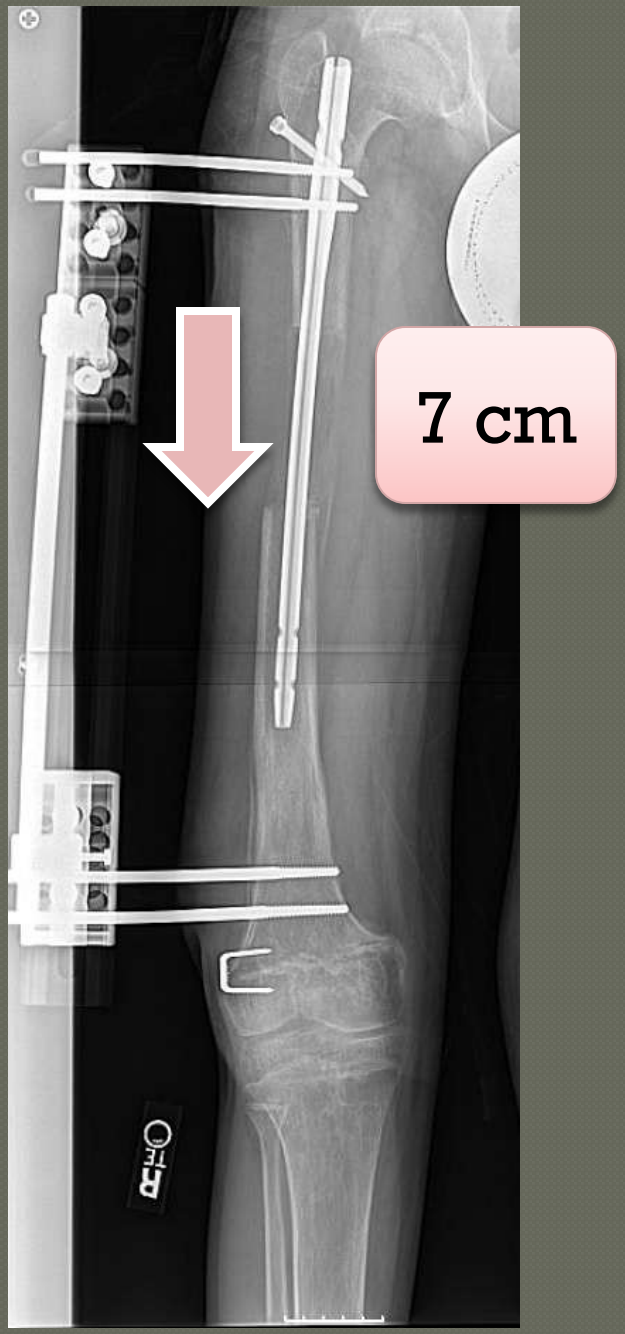

ANOOGA GROUP

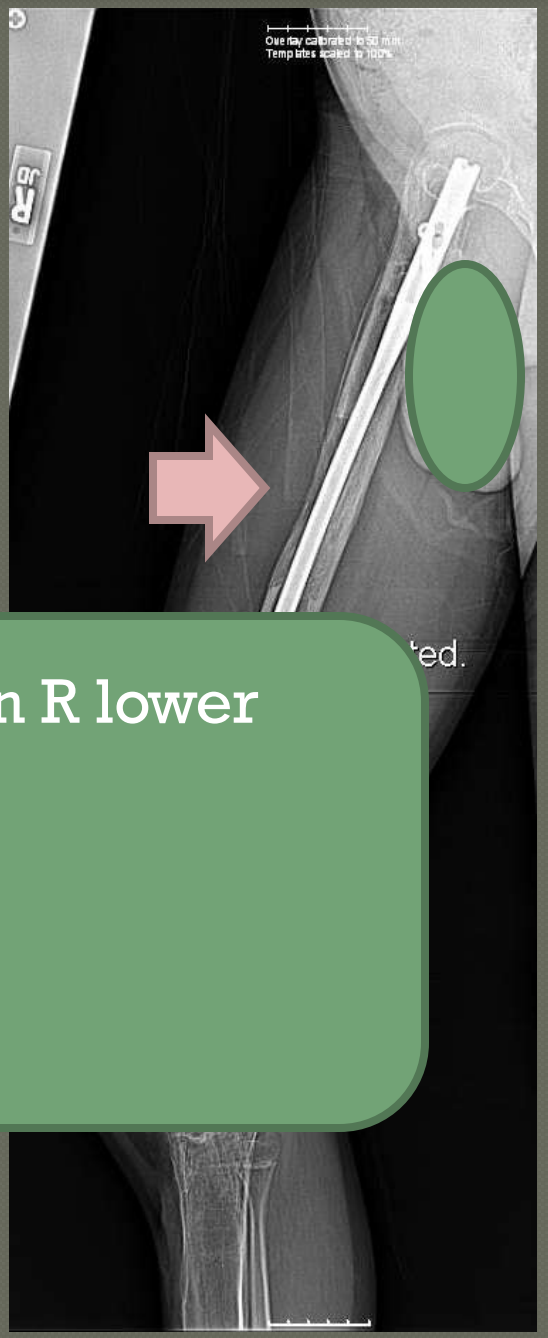

ARMY


9 cm
SUPINE
R
AD

7 cm LLD
At age 15


NIKE


7 cm



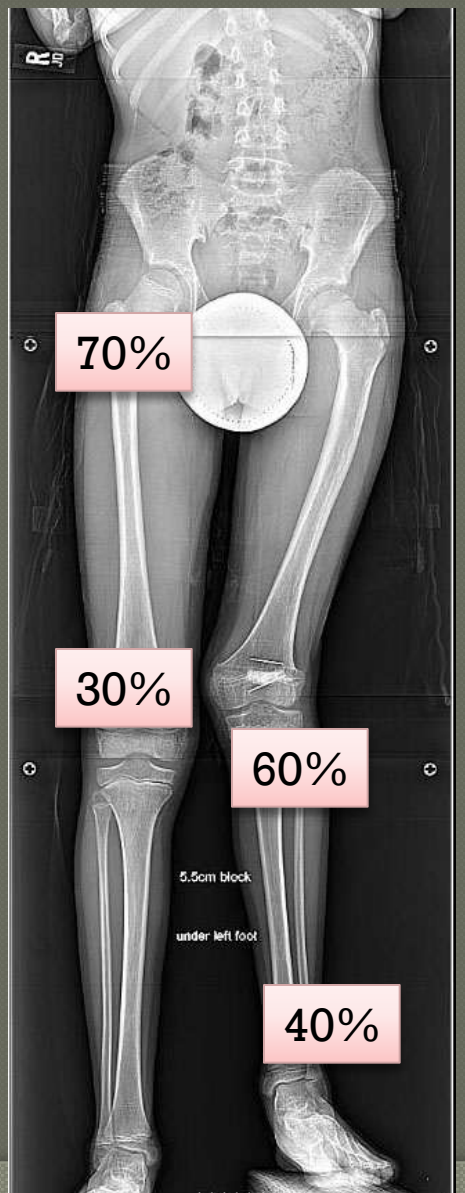
Total Lengthening on R lower extremity

5+9+7=

21 cm

Growth arrest

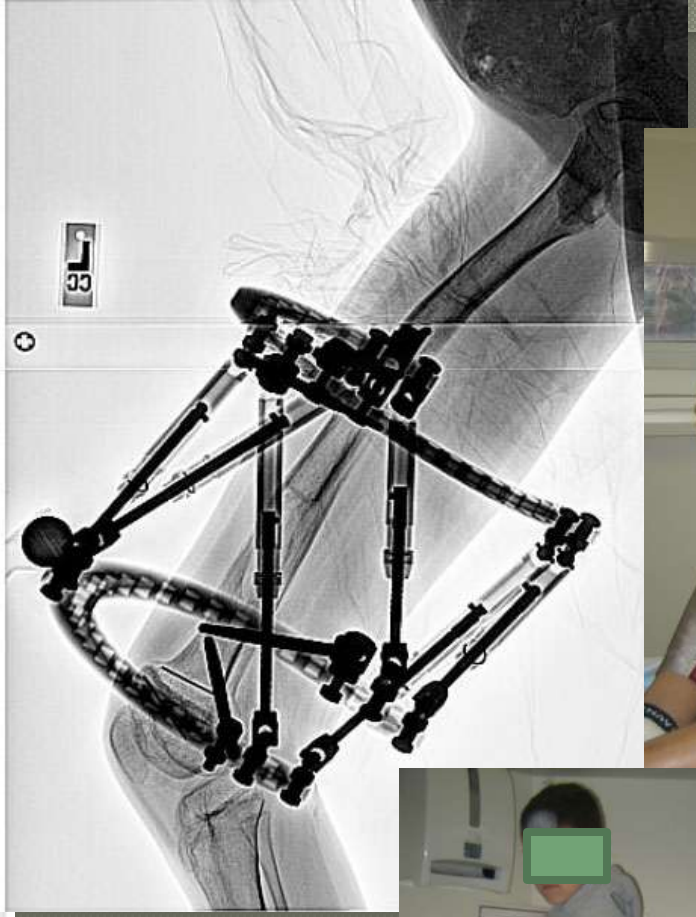
- Relative contributions of various growth plates



Age 8
Distal femur growth arrest
Proximal tibial also
LLD 7 cm
Valgus deformity

PLLD
M= 1.47
R femur= 350 x 1.47
R femur will be 515
515-350= 165 mm
165 x 70%= 11.5 cm

Plan: lengthen femur 7 cm, correct valgus, Close growth plate. Second lengthening of about 5 cm. femur and / or tibia




FOOTBALL IS
EVERYTHING
LACROSSE


lift/no shoes

12 y/o, sarcoma excision prox tibia
Reconstructed with free fibula.
Nonunion, varus deformity, growth
Arrest proximal tibia, flap-poor skin

R, L tibia 300mm
M=1.18
300 x 1.18= 354
354- 300= 54 mm
54 mm x 60%= 33 mm


HOSP FOR SP


R
J0
1
CHAIN;ADAM R

L ankle valgus from free fibula
Donor site

Age 15.5
L ankle straight, R tibia healed.
LLD 3 cm

Plan: lengthen femur.
Avoid tibia

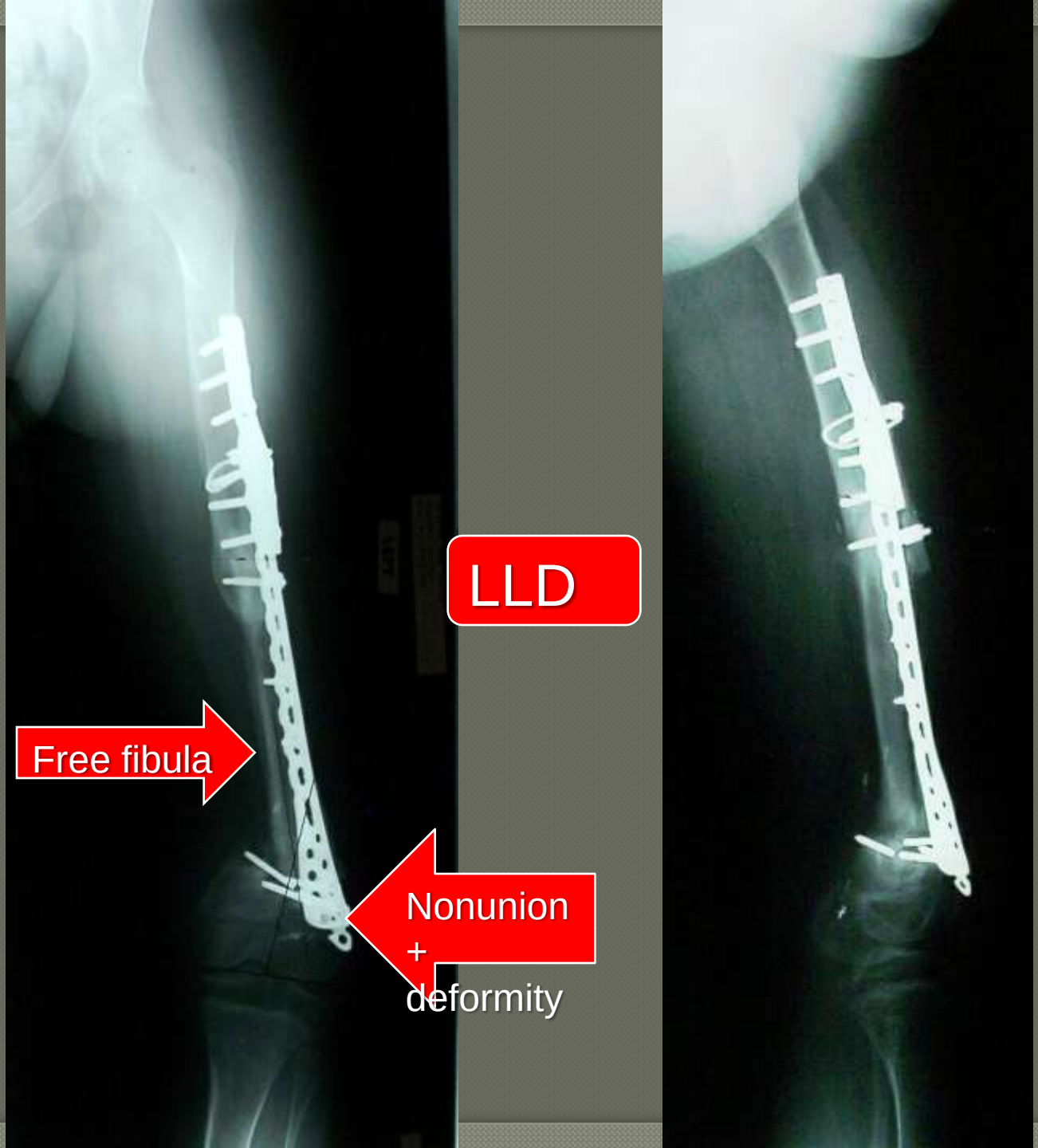
ge
17

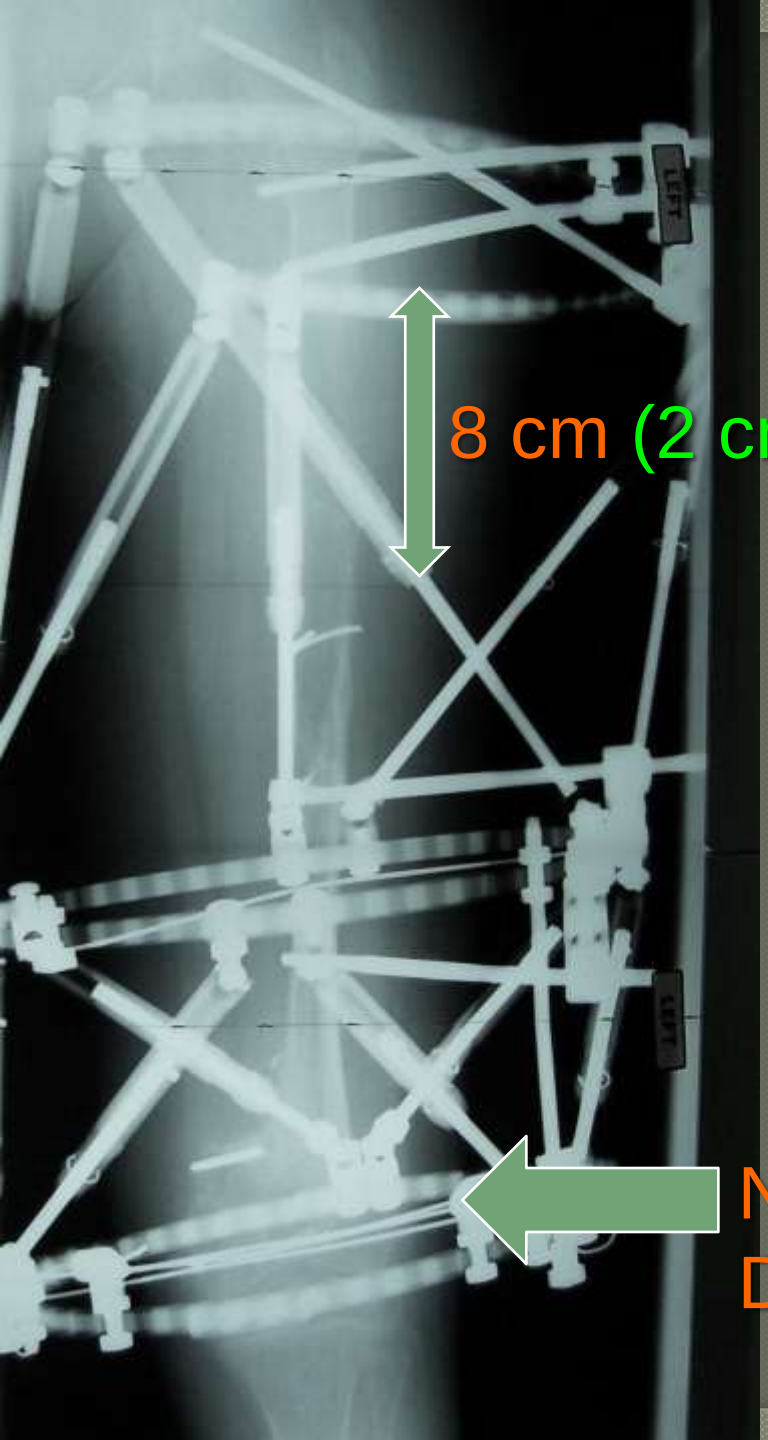

R
OB


R
OB


L
OB

Failed free fibula reconstruction of Osteosarcoma resection


LLD
Free fibula
Nonunion
+
deformity

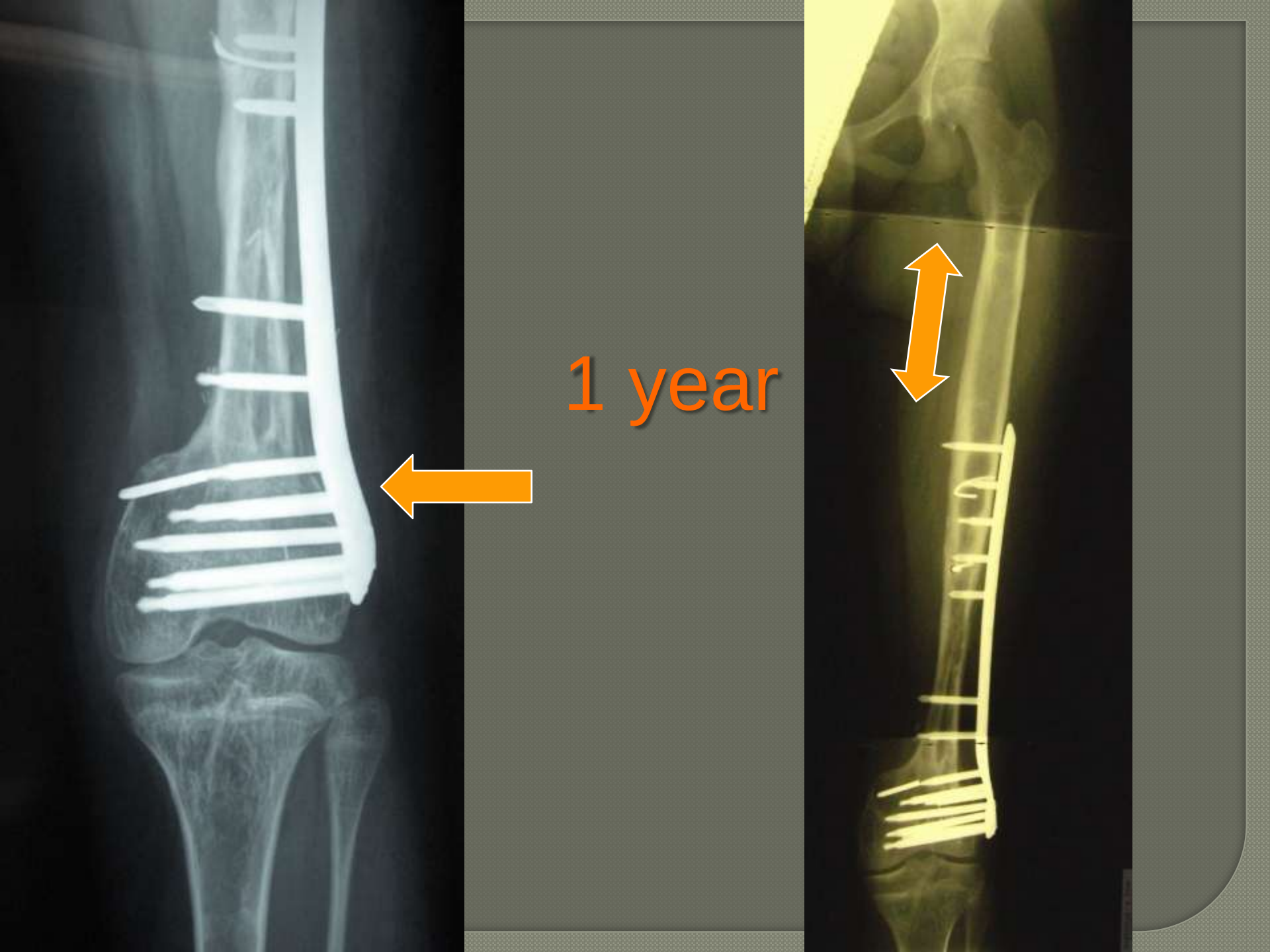


Nonunion repair
Deformity correction

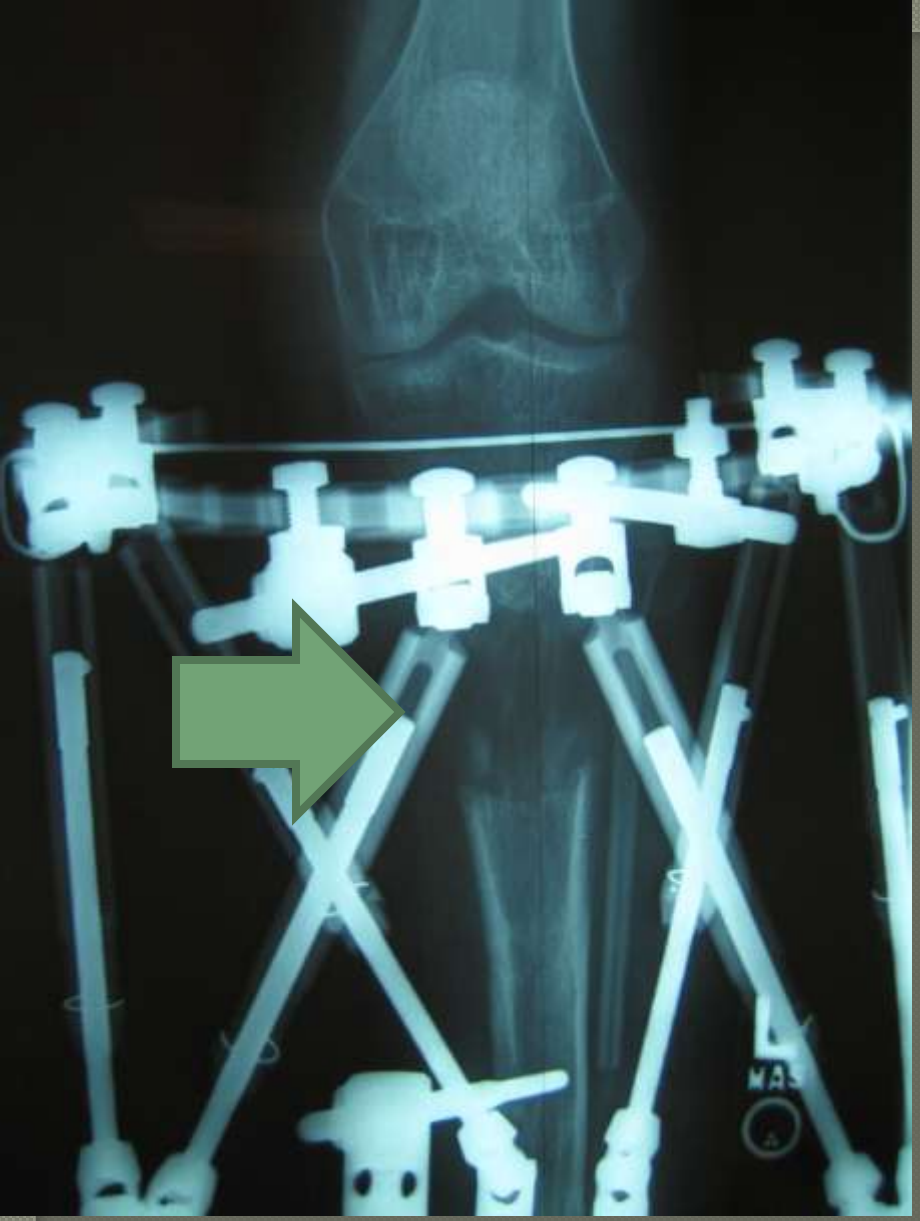

8 cm
Fracture of fibula

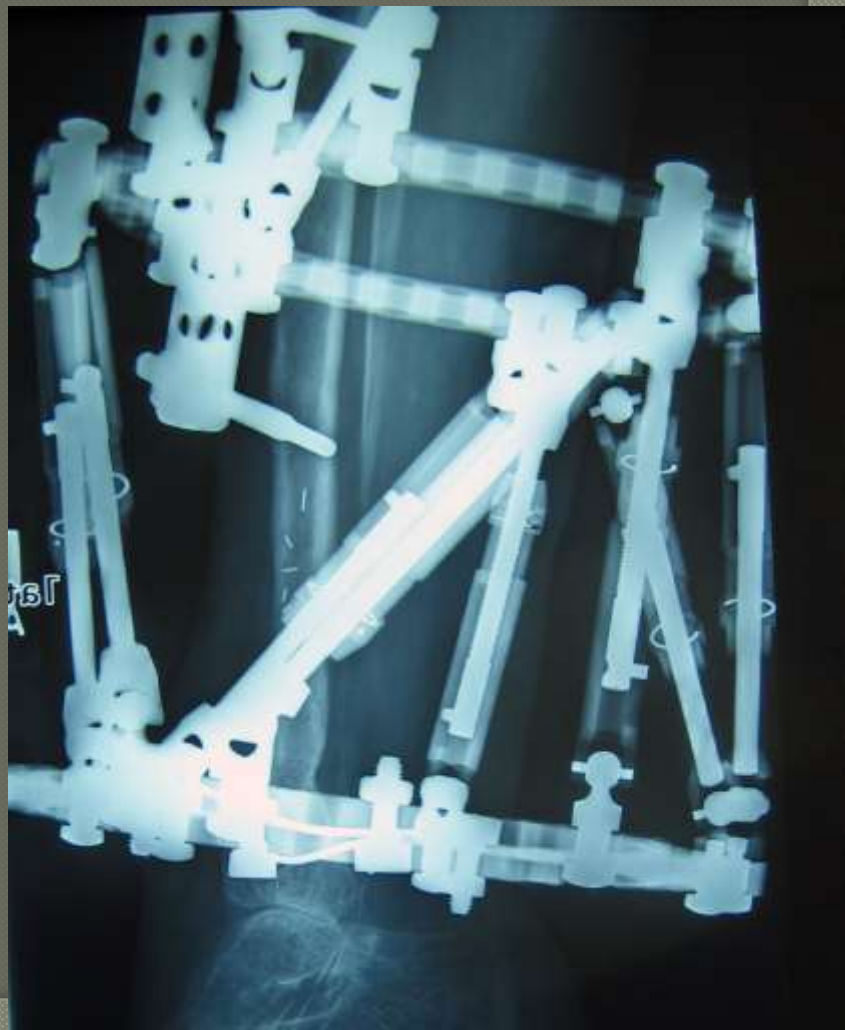

6 mos

1 year

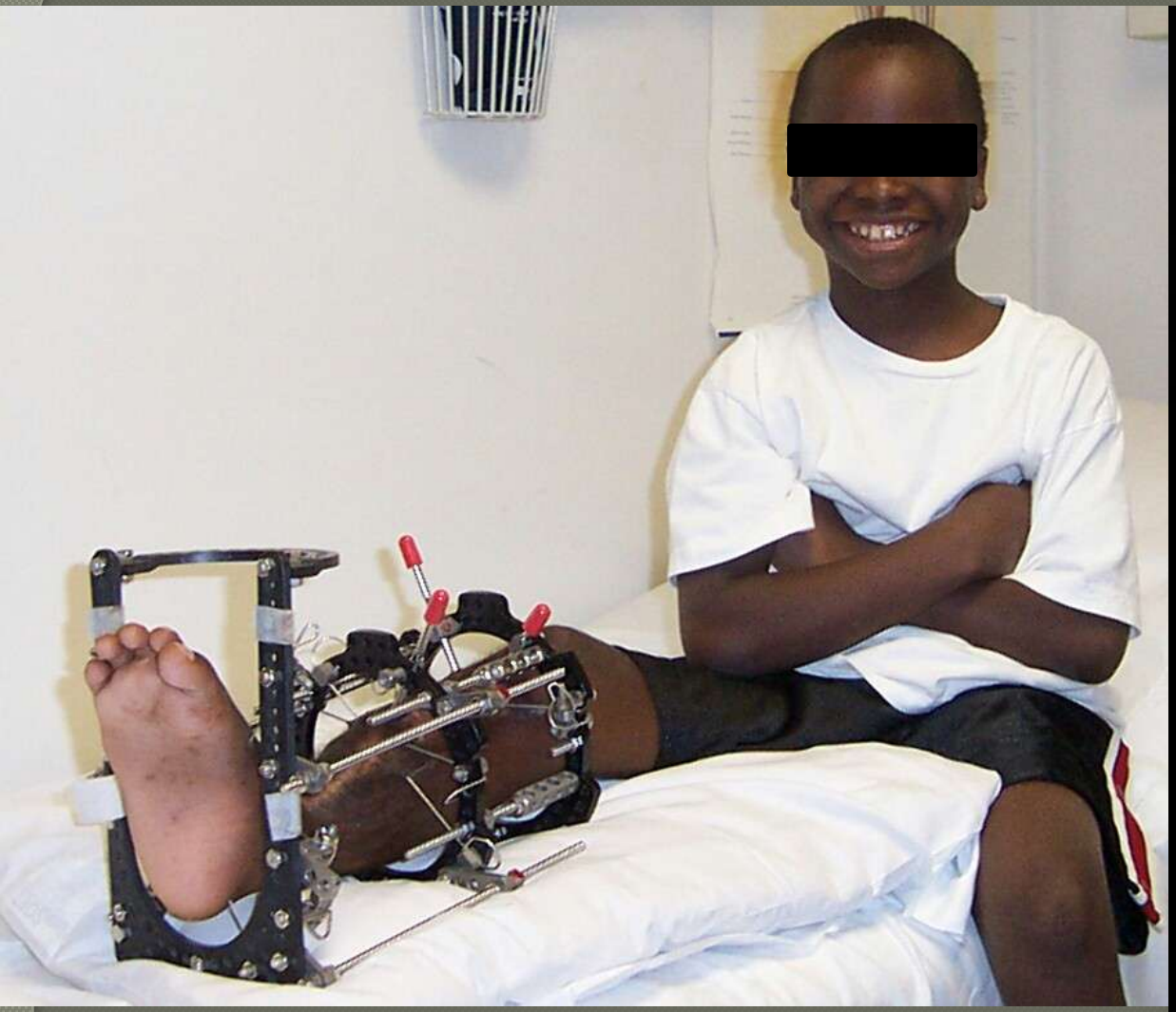

1 year

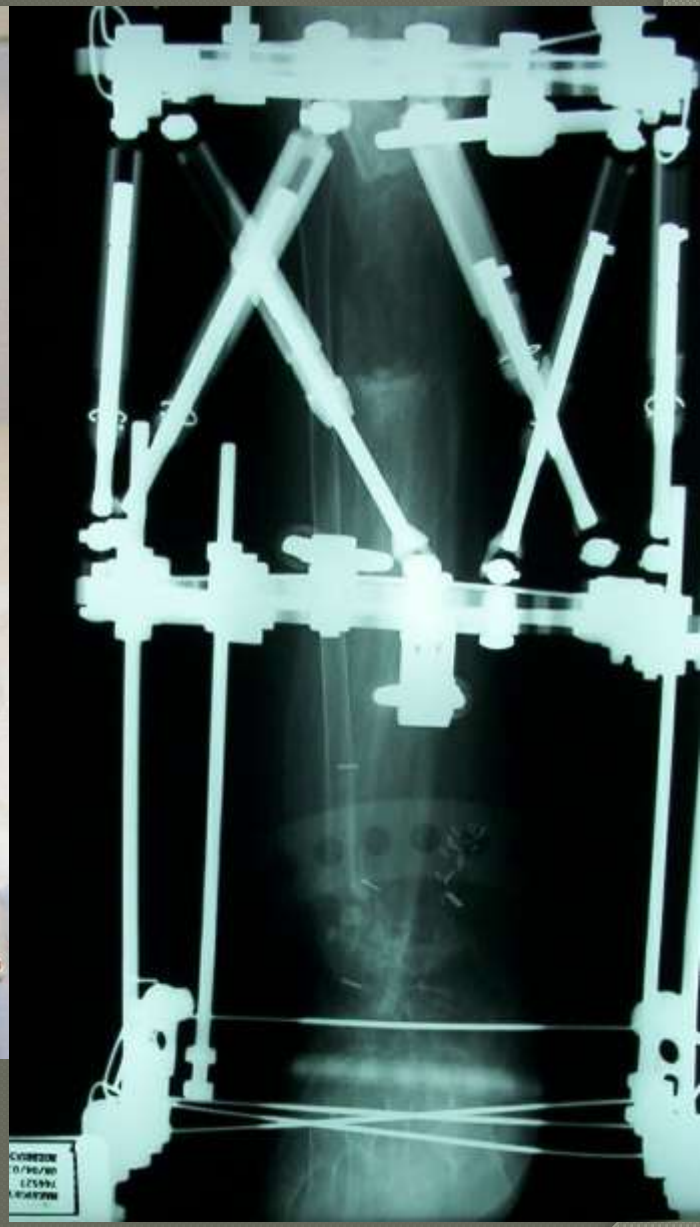
CPT- congenital pseudoarthrosis of tibia






R
J0
1

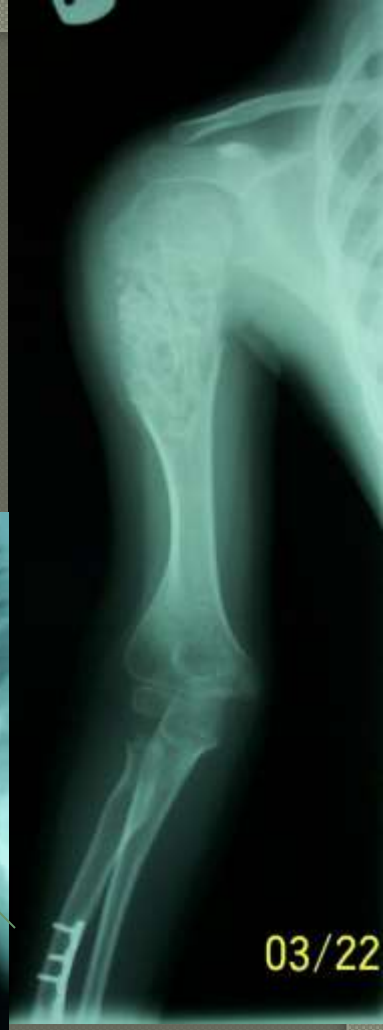


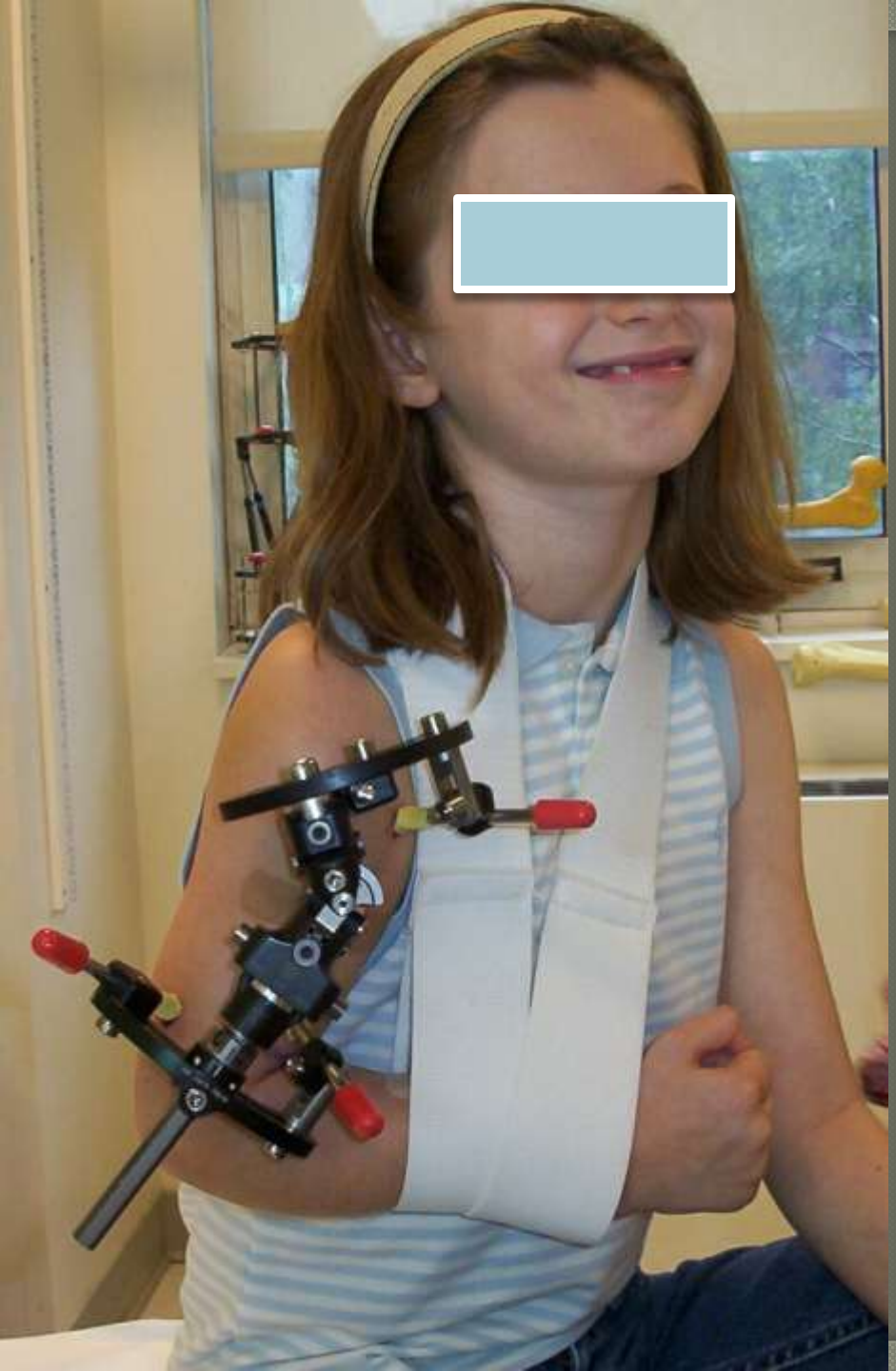



06/15/2004


24
27

Ollier’s Disease



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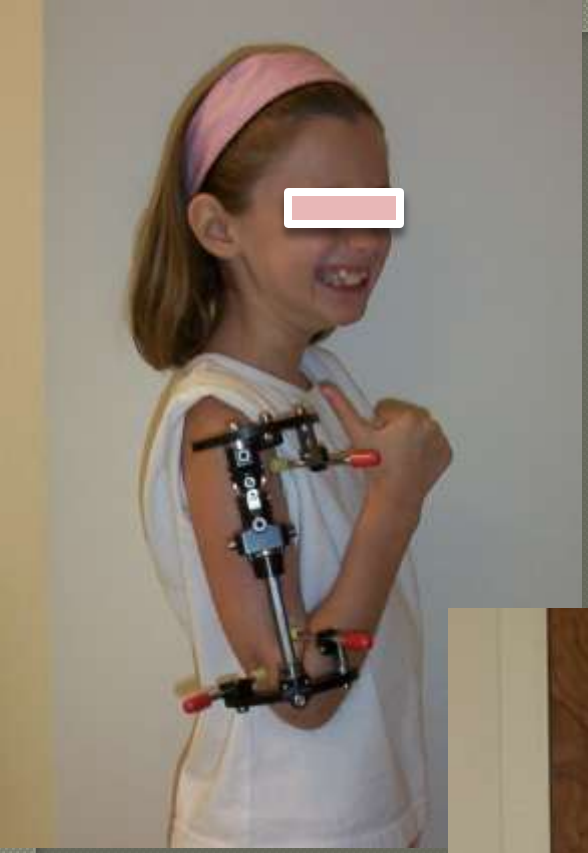
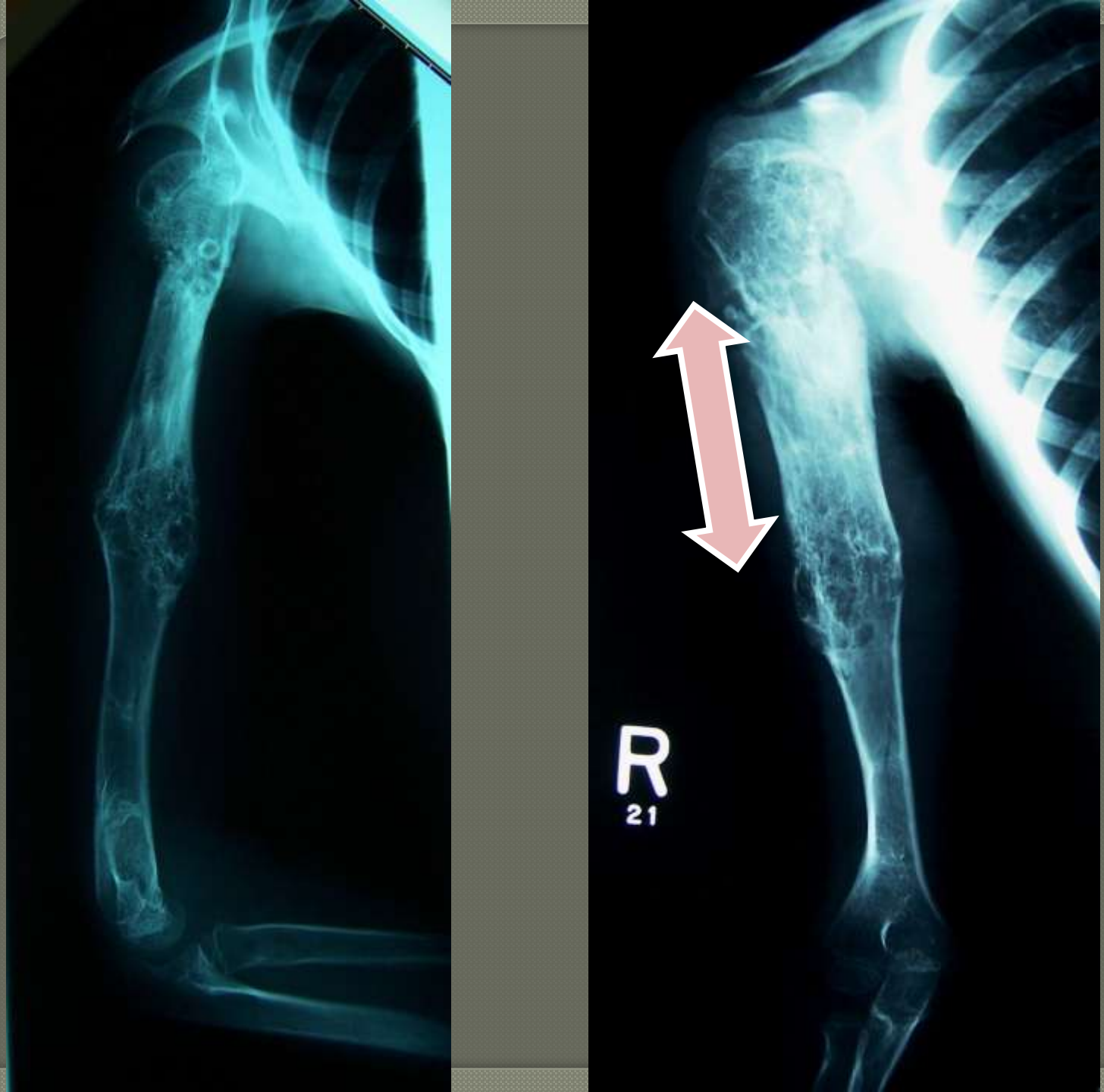


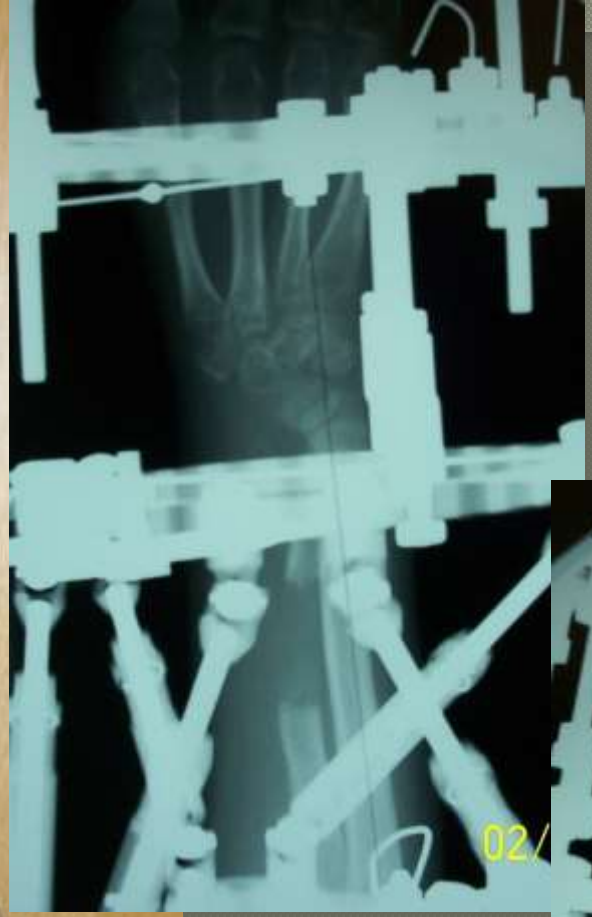

RT
11/16/


11/16/2


R
21


10/29/20


TROGDOR!!
THE BURNINATOR
03/0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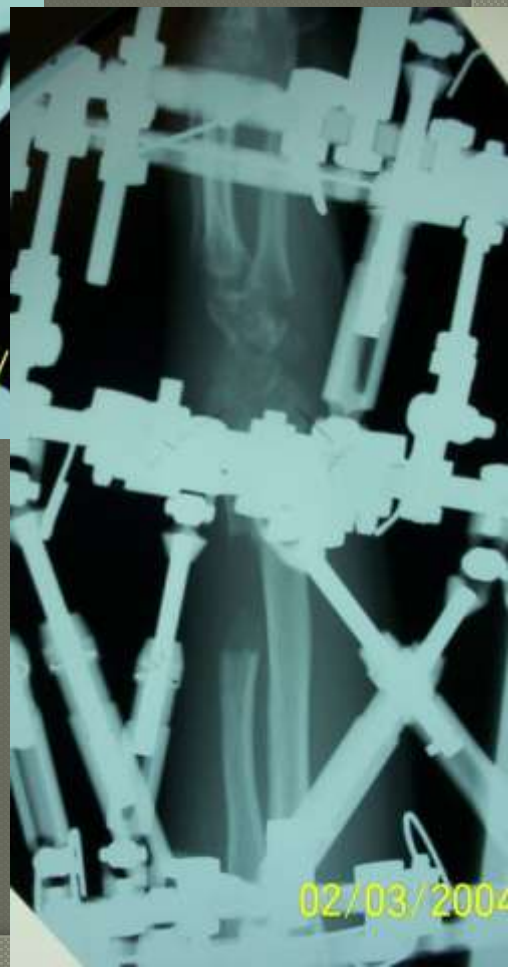
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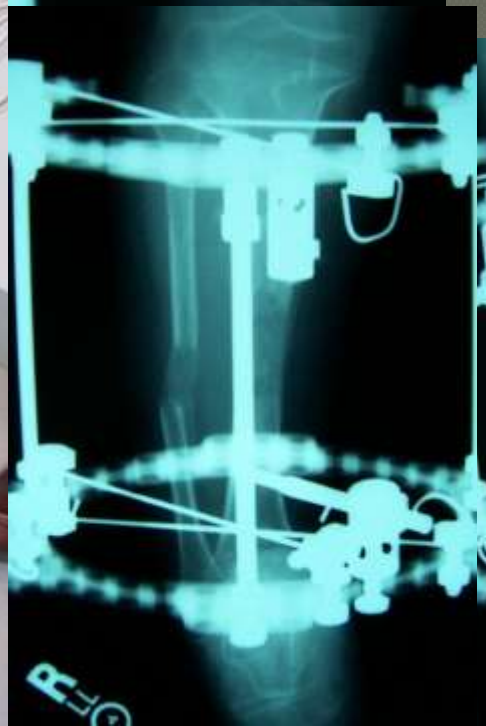
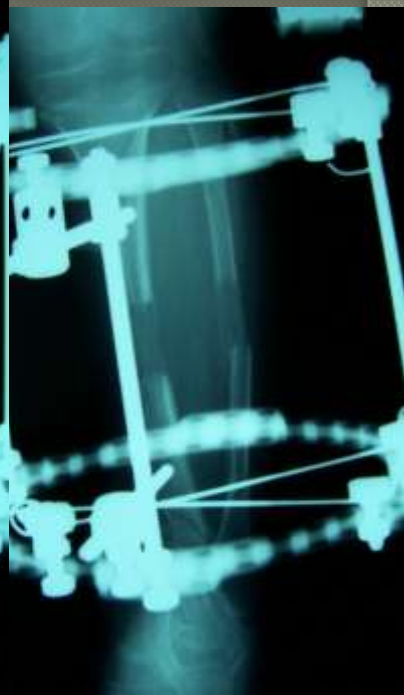
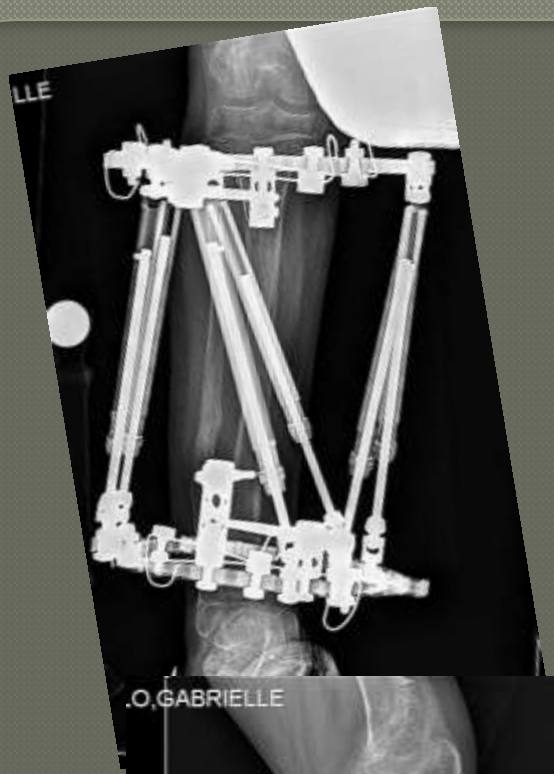
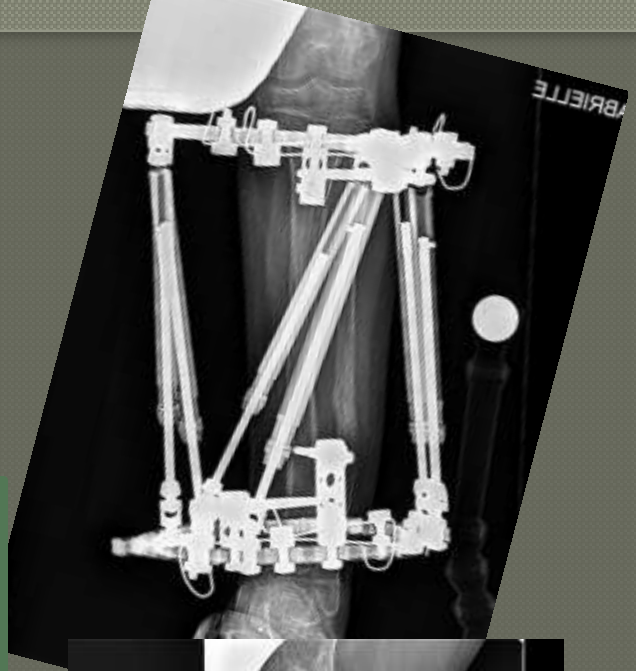
Carlsberg


JBJS

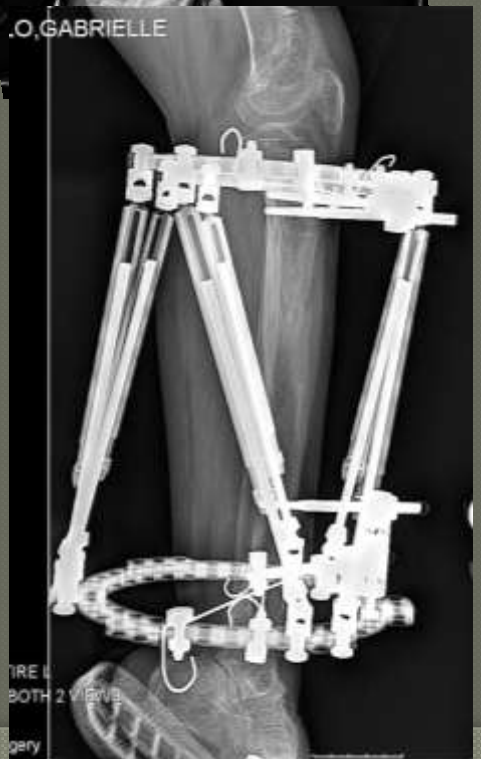


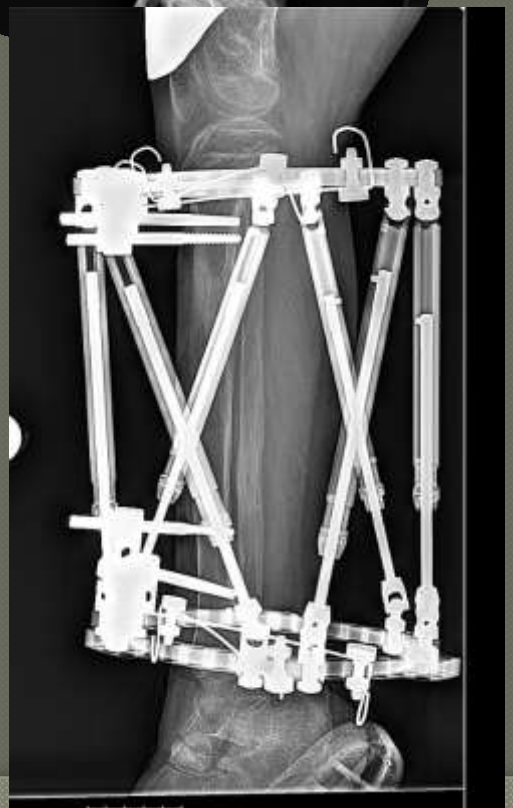






10 cm
Bilateral
tibial
lengthening
Age 13






R
OB


SMGH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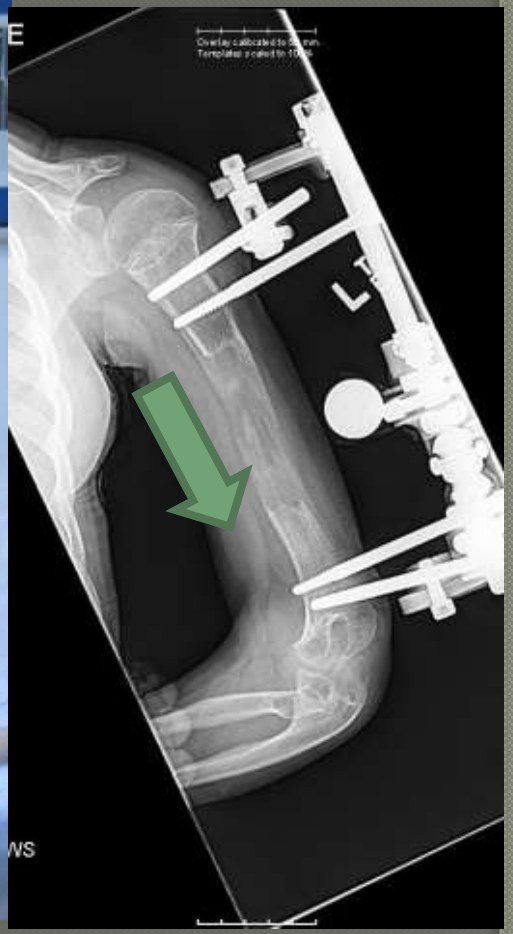
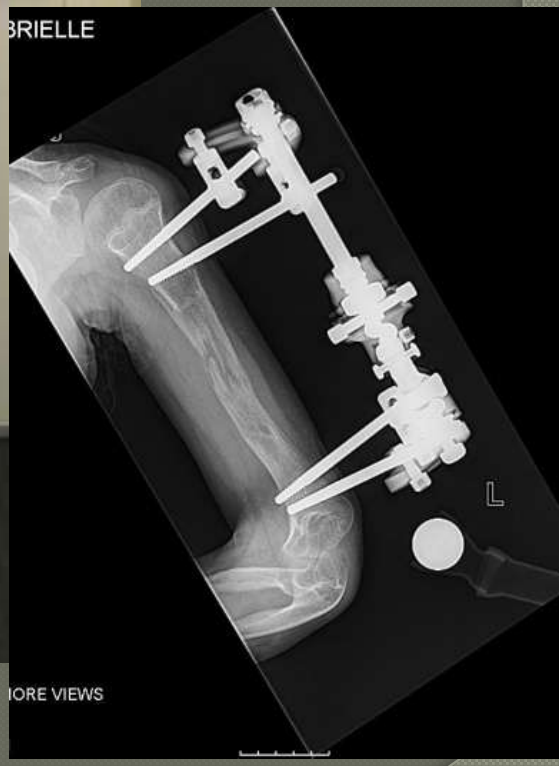
OB


RIELLE
nually calibrated.
LAT
RT
E
RE VIEWS


E
WS


S.M.G.H.
S.M.G.H.


BRIELLE
L
ORE VIEWS


4’ 11”
09/24/20


R


R
AS


L
AS

7 cm


R
L

Blount's Disease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LIMB LENGTHENING.COM
www.hss.edu/limblengthening