



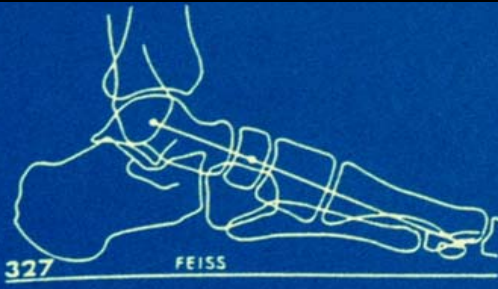
Collège Hospitalier et Universitaire
de Chirurgie Pédiatrique

DESC de Chirurgie Pédiatrique

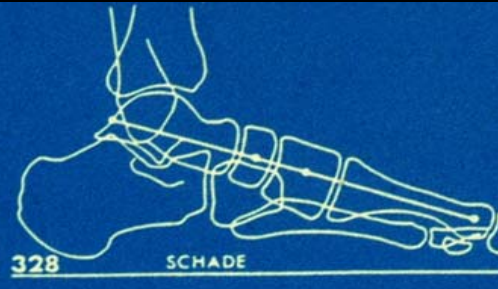
Session de Septembre 2009 - PARIS

Pied creux

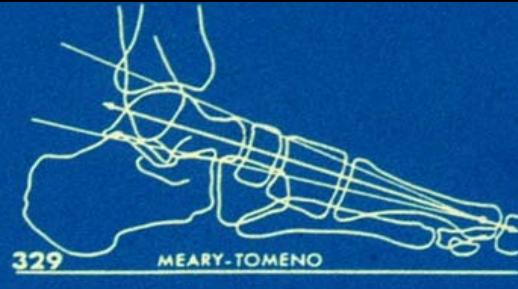
P Wicart, R Seringe



327 FEISS



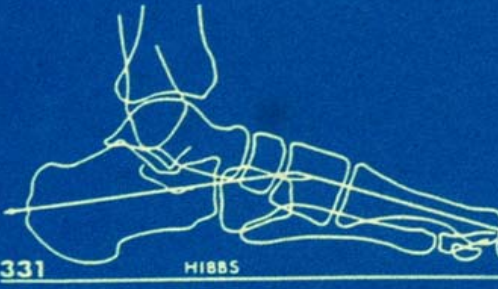
328 SCHADE



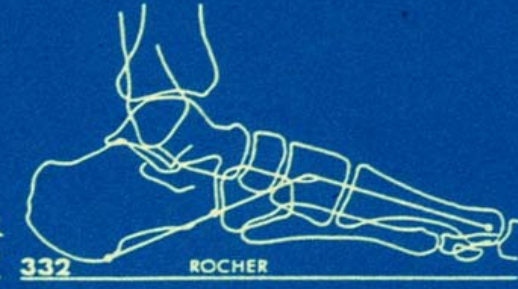
329 MEARY-TOMENO



330 GIANNESTRAS



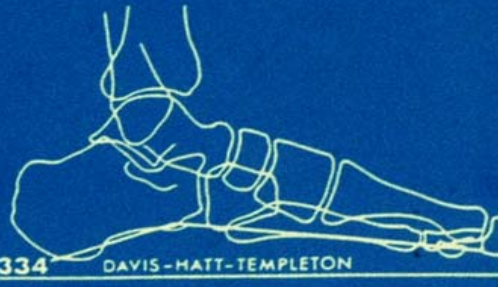
331 HIBBS



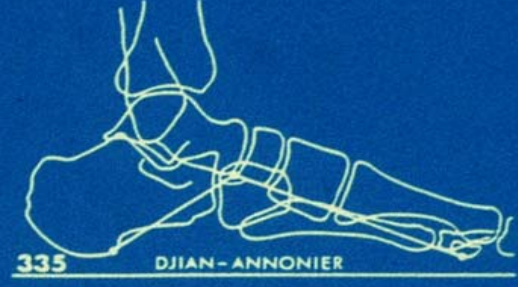
332 ROCHER



333 CAPLAN-SIMMONDS



334 DAVIS-HATT-TEMPLETON



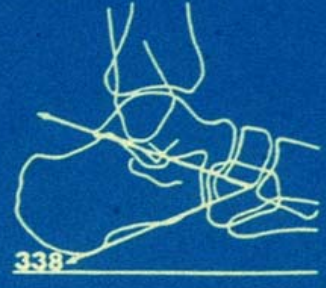
335 DJIAN-ANNONIER



336 FICK



337

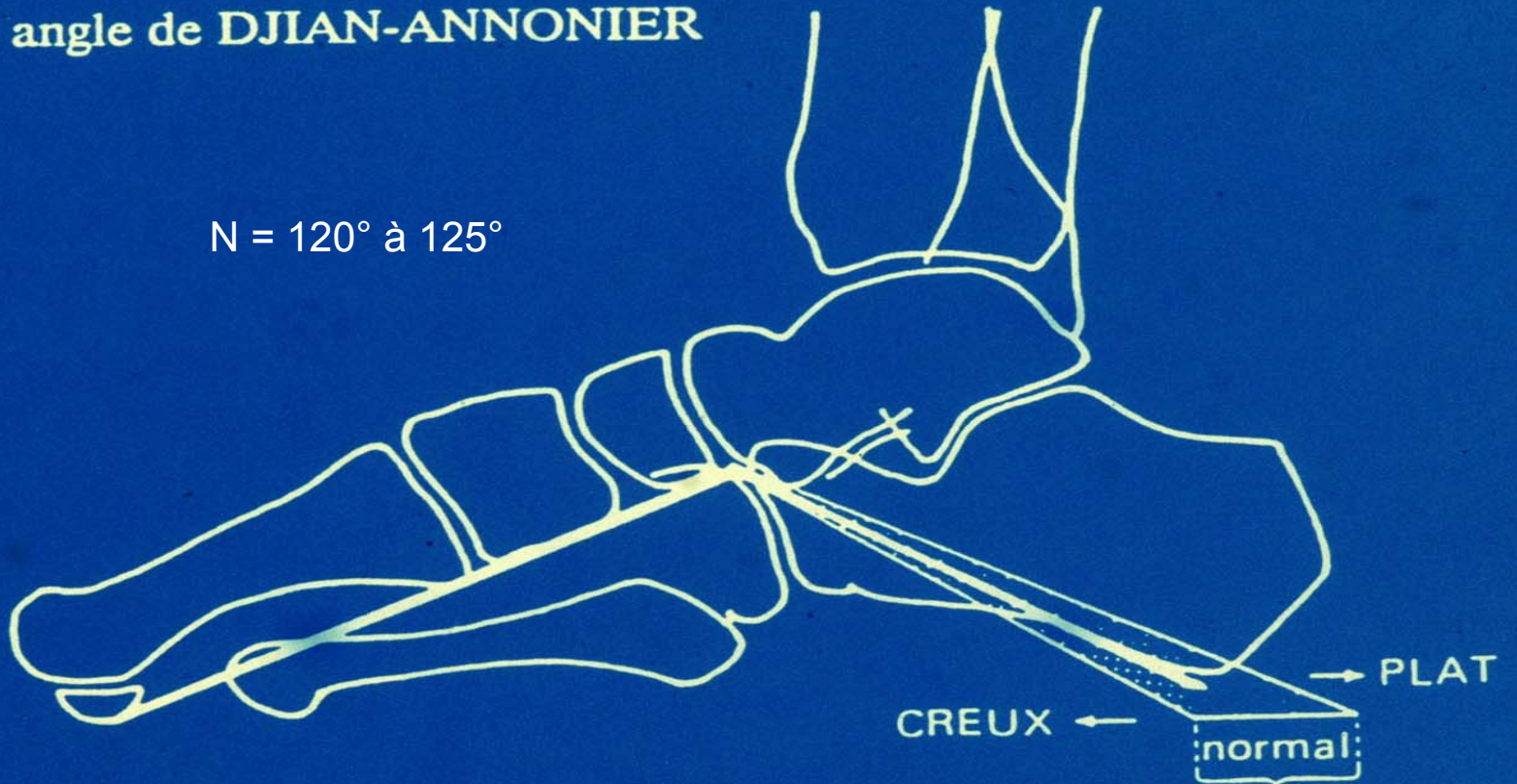


338

NORMAL FOOT

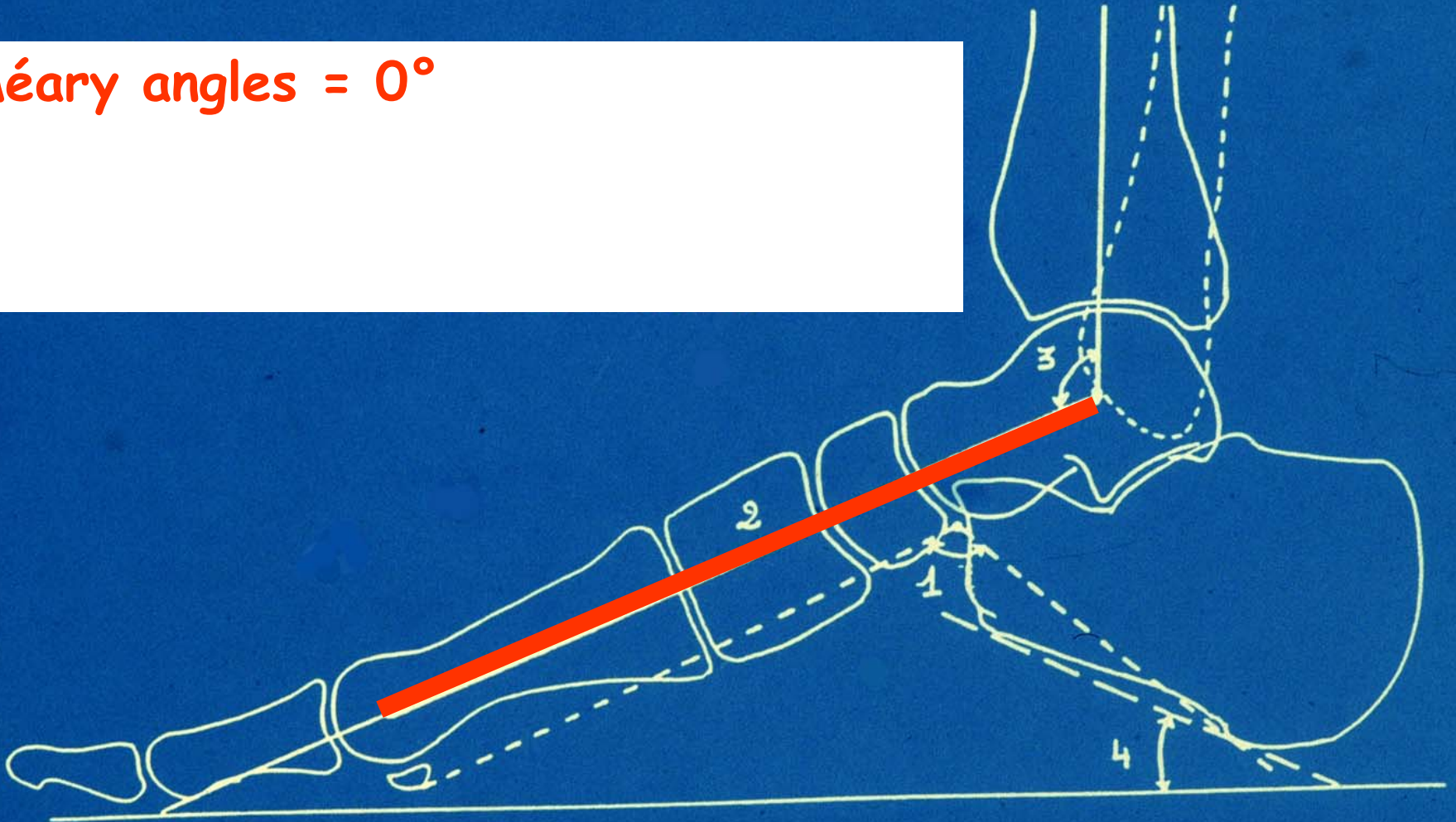
angle de DJIAN-ANNONIER

N = 120° à 125°



NORMAL FOOT

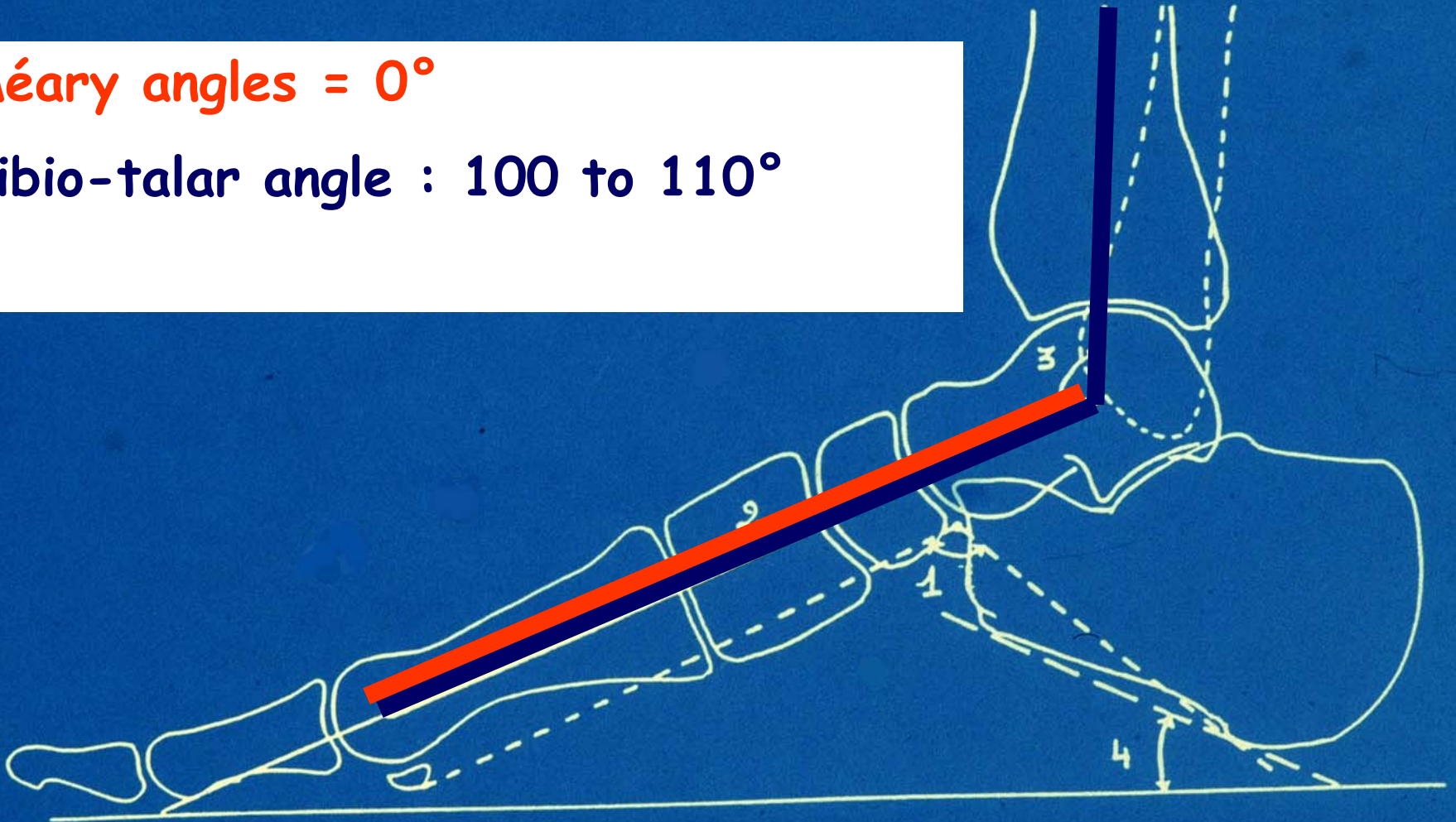
Méary angles = 0°



NORMAL FOOT

Méary angles = 0°

Tibio-talar angle : 100 to 110°

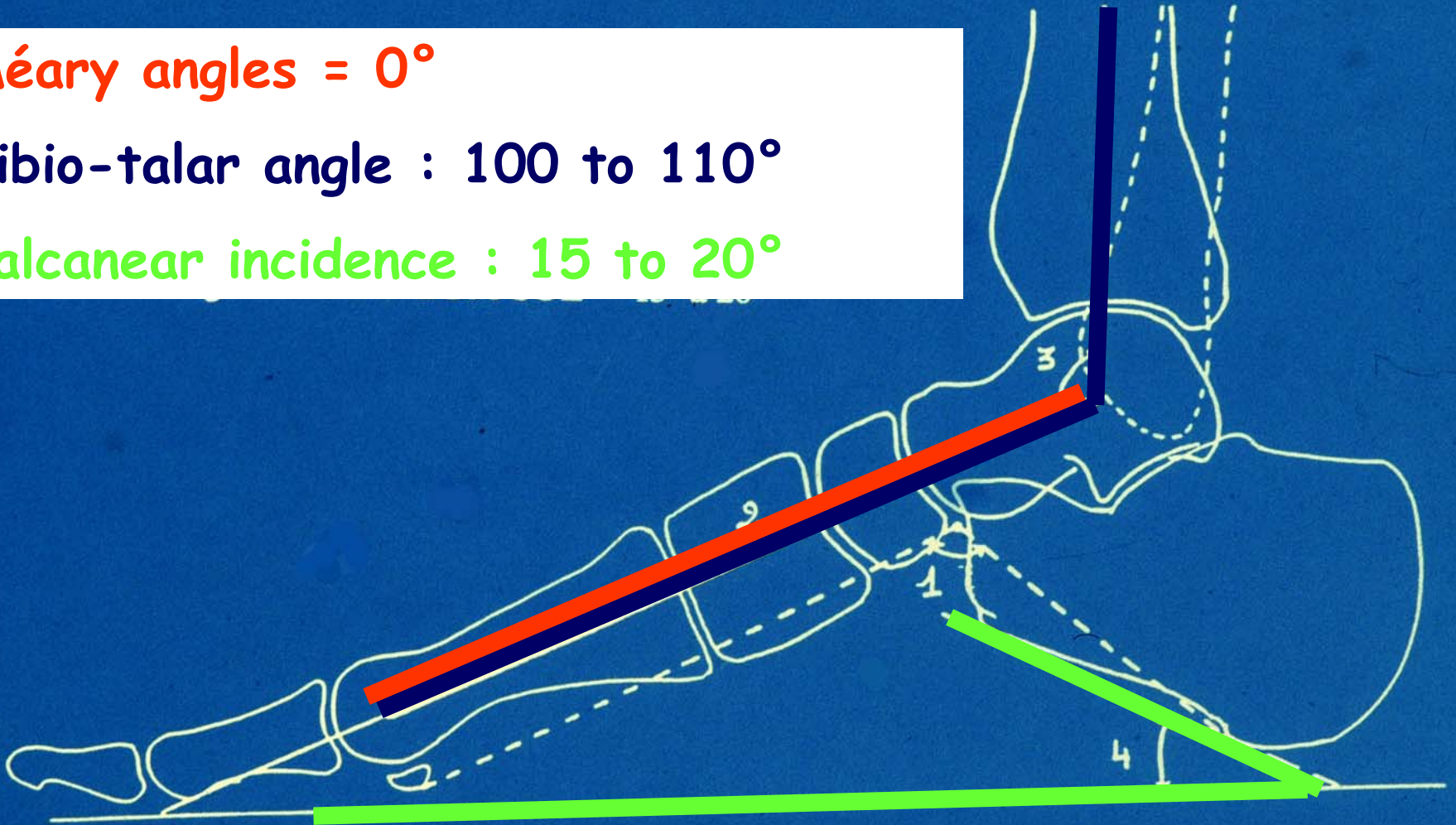


NORMAL FOOT

Méary angles = 0°

Tibio-talar angle : 100 to 110°

Calcaneal incidence : 15 to 20°



Direct pes cavus



Direct pes cavus



Pes cavo-varus



Direct pes cavus

Calliper +++

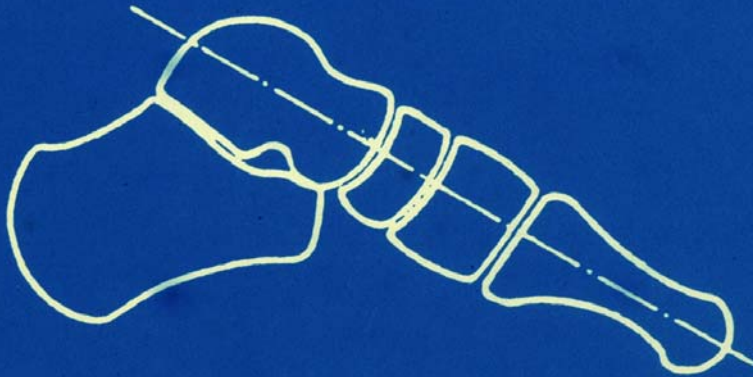
- Anterior branch : anterior pes cavus
- Posterior branch : posterior pes cavus
- Anterior and posterior : combined pes cavus



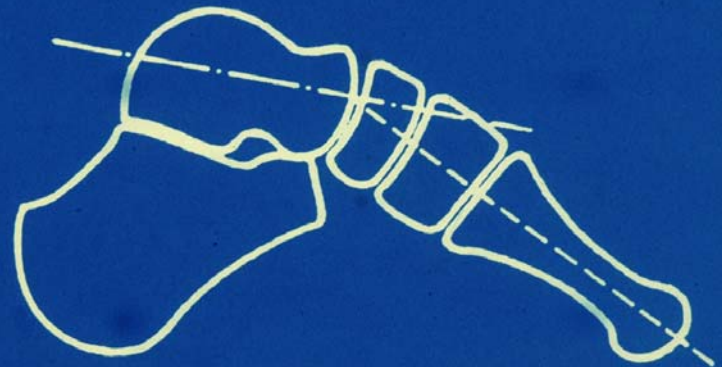
Anterior direct cavus foot

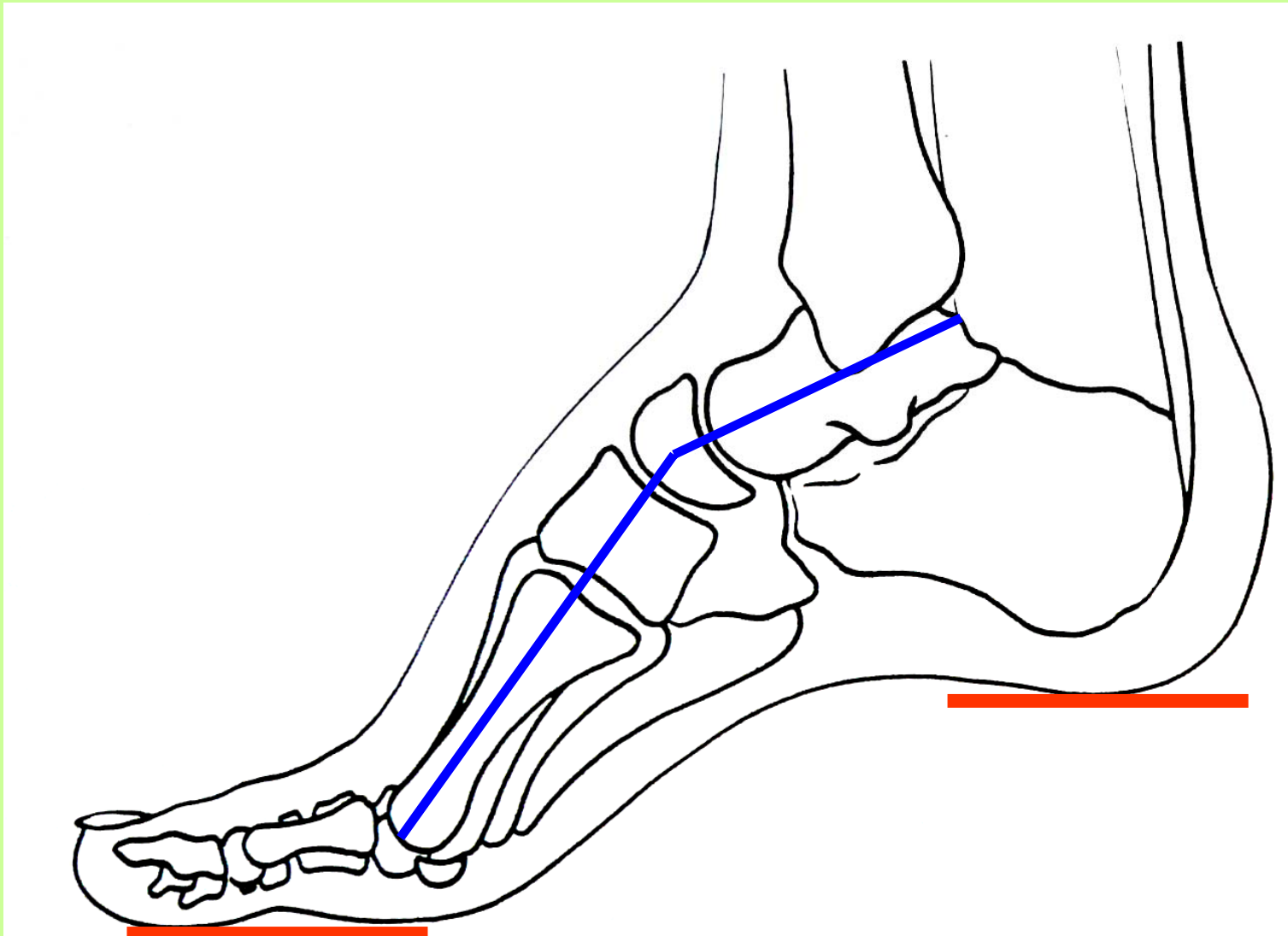
Méary's line and angle

ligne de MEARY



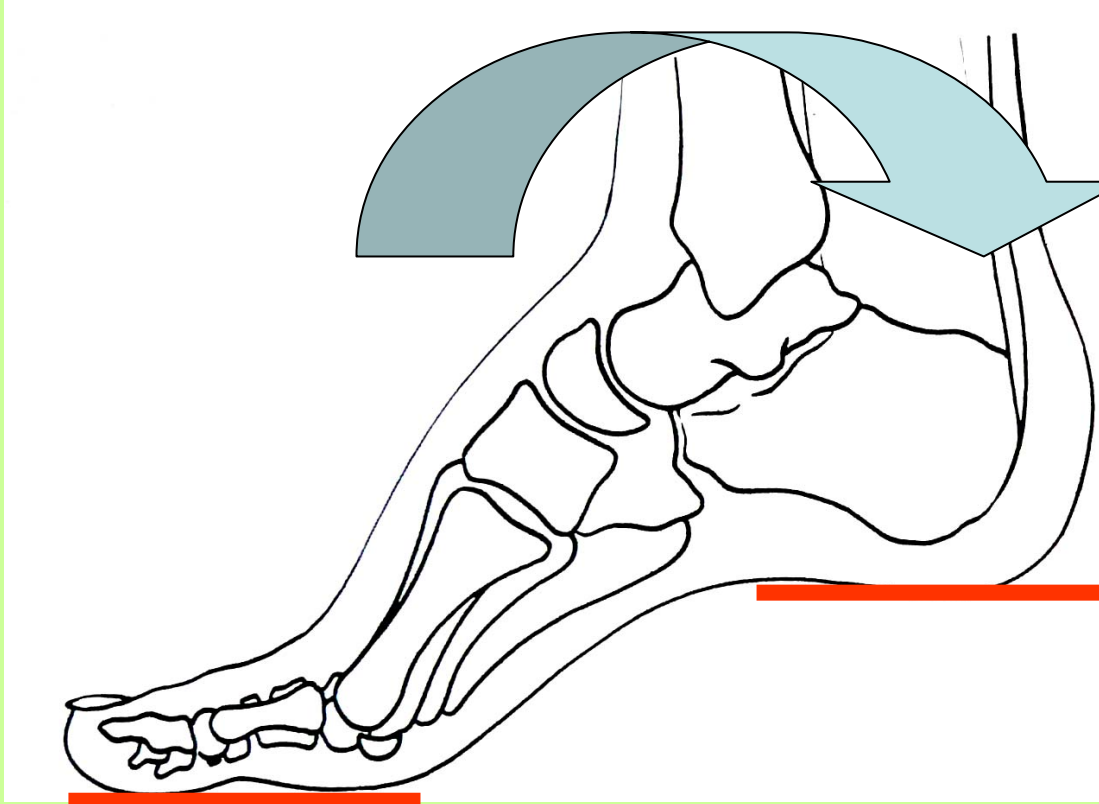
angle de MEARY





Anterior direct pes cavus : Mid/forefoot equinus

Tibio-talar Compensatory dorsal flexion



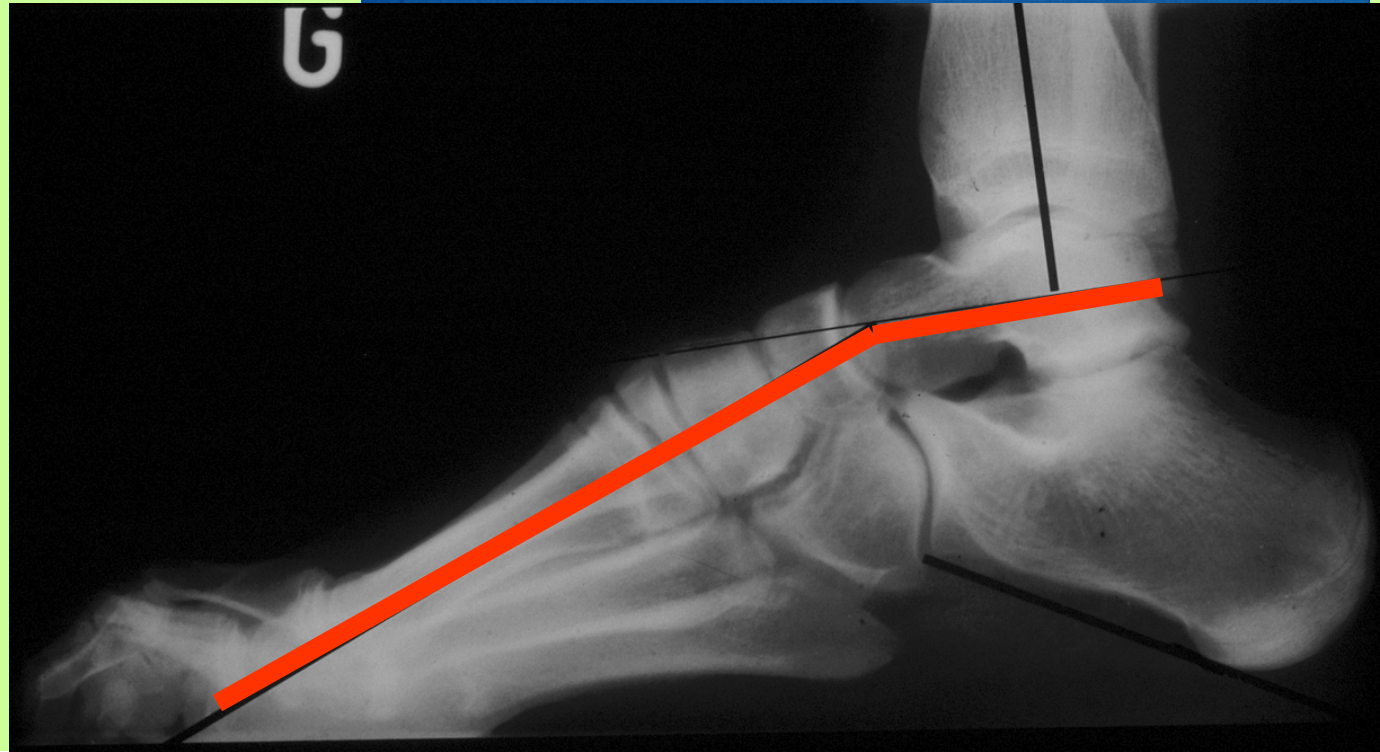
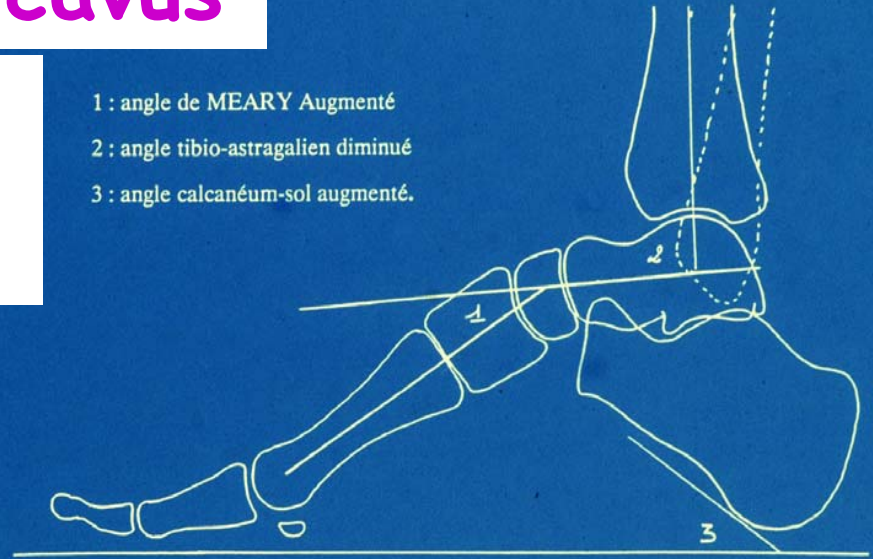
Anterior direct pes cavus

Méary angle



PIED CREUX DIRECT ANTERIEUR

- 1 : angle de MEARY Augmenté
- 2 : angle tibio-astragalien diminué
- 3 : angle calcanéum-sol augmenté.



Anterior direct pes cavus

Méary angle

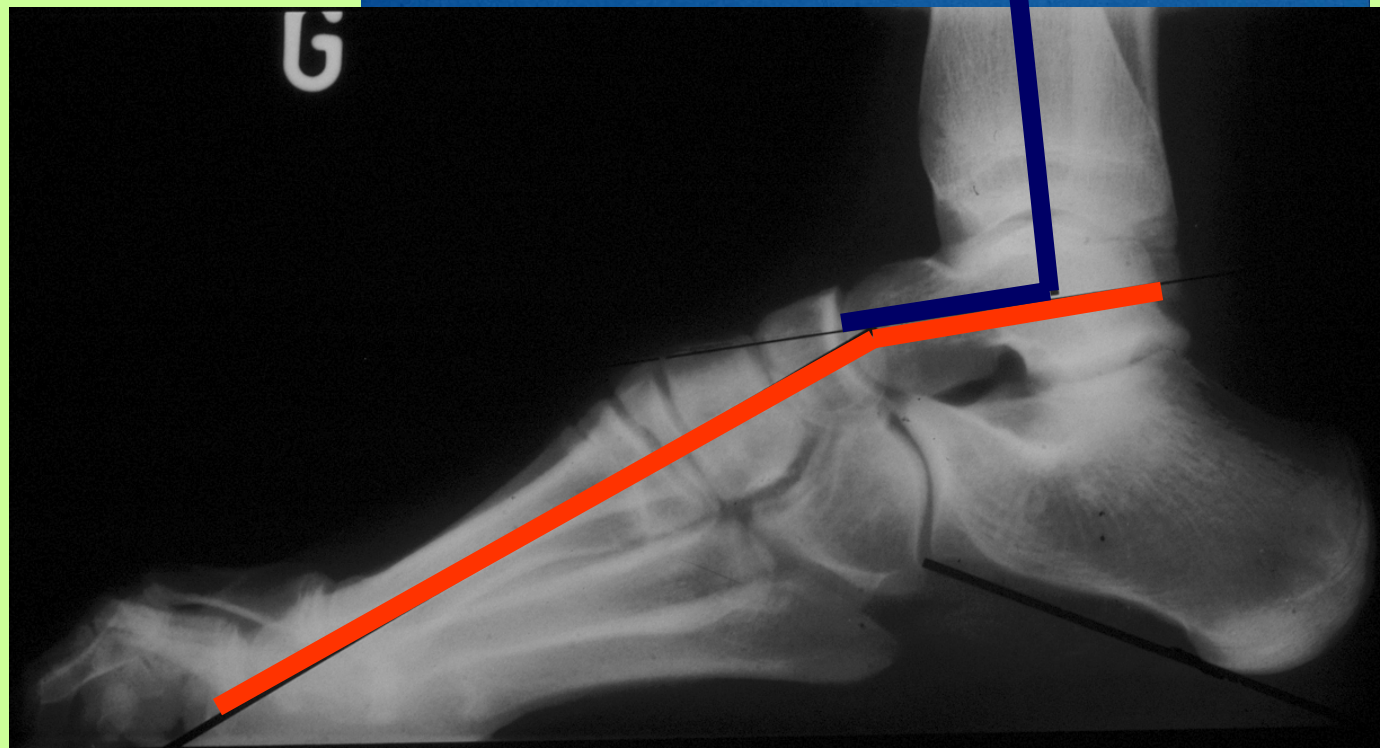
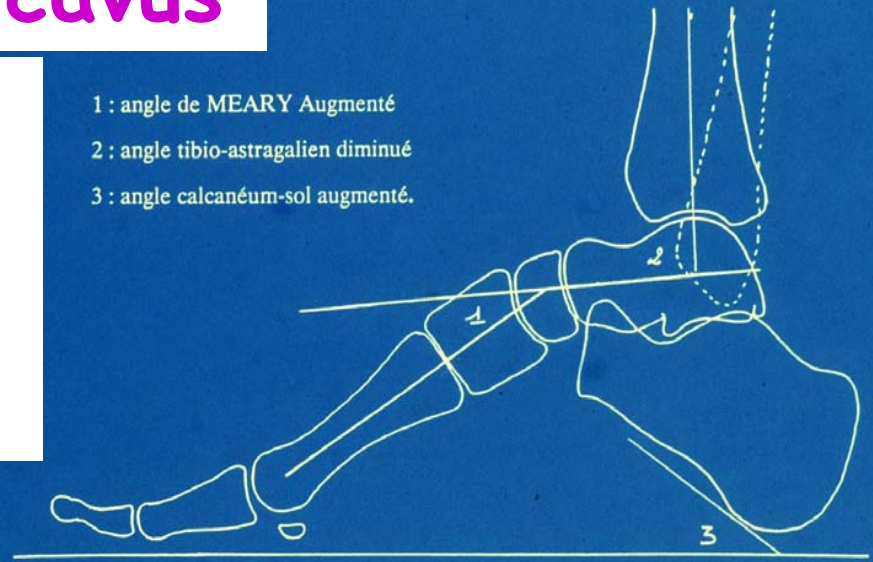


Tibio-talar angle



PIED CREUX DIRECT ANTERIEUR

- 1 : angle de MEARY Augmenté
- 2 : angle tibio-astragalien diminué
- 3 : angle calcanéum-sol augmenté.



Anterior direct pes cavus

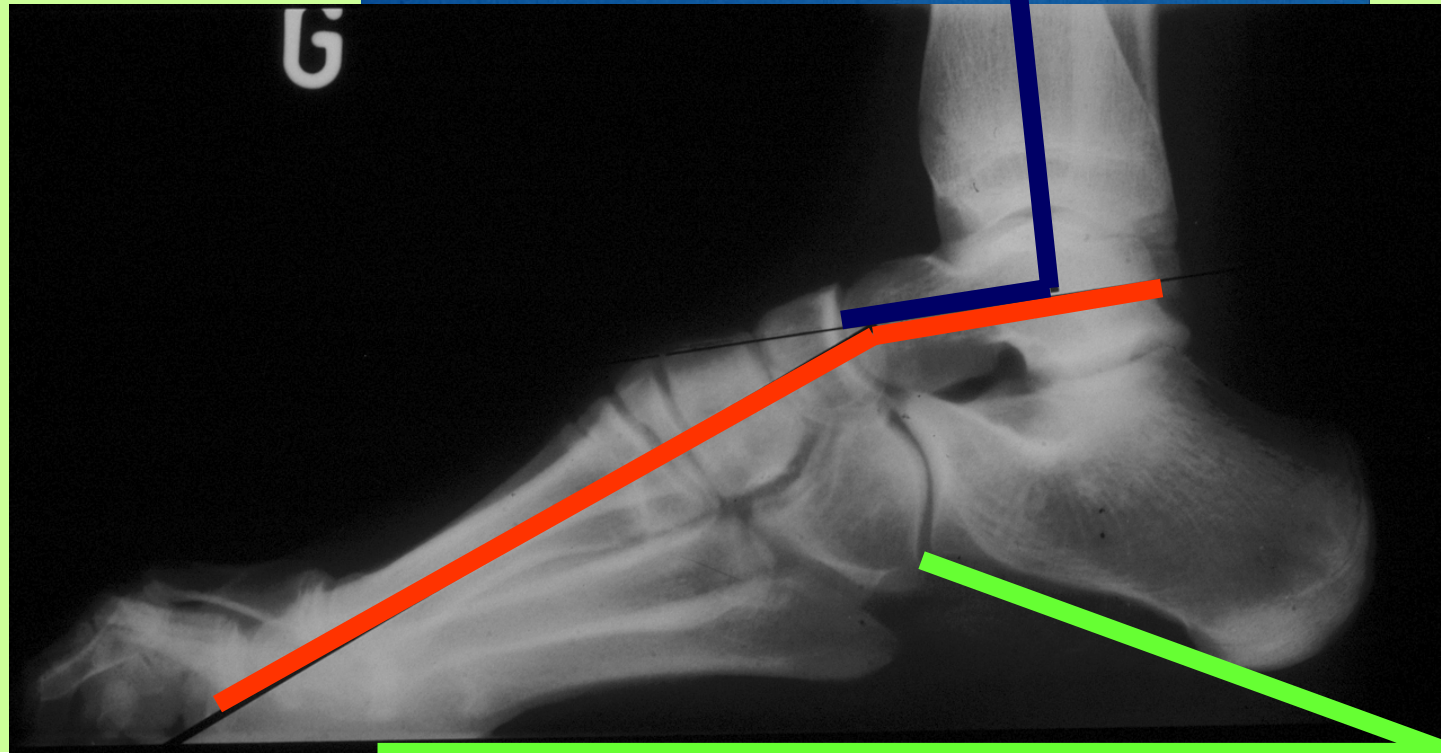
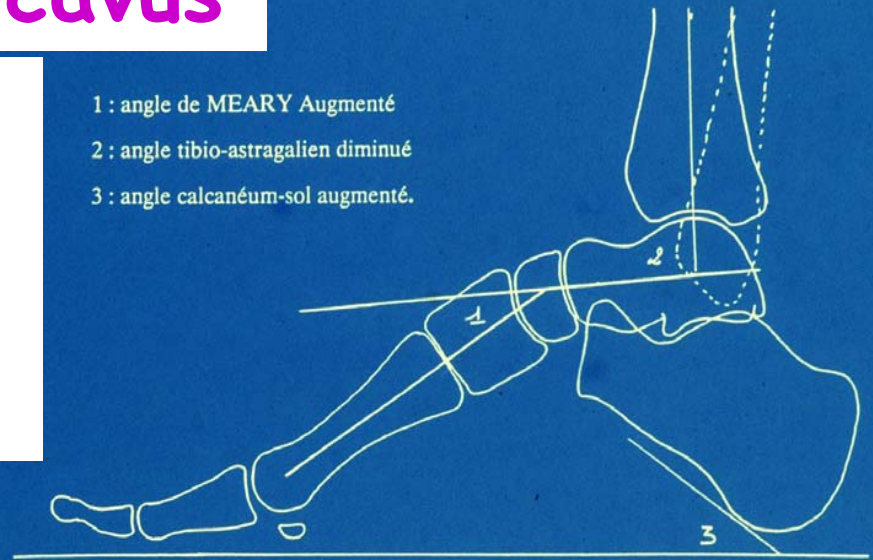
Méary angle 

Tibio-talar angle 

Calcaneal incidence 

PIED CREUX DIRECT ANTERIEUR

- 1 : angle de MEARY Augmenté
- 2 : angle tibio-astragalien diminué
- 3 : angle calcanéum-sol augmenté.

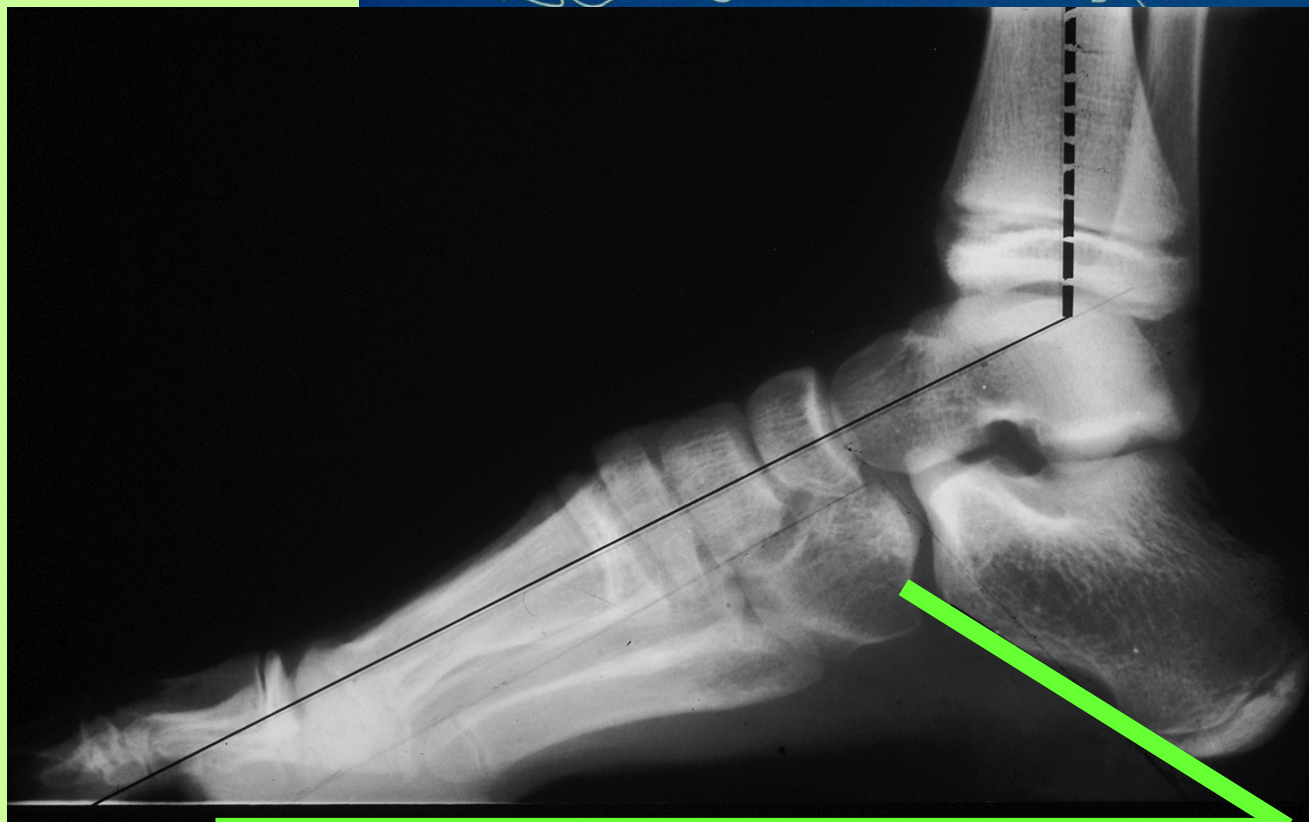
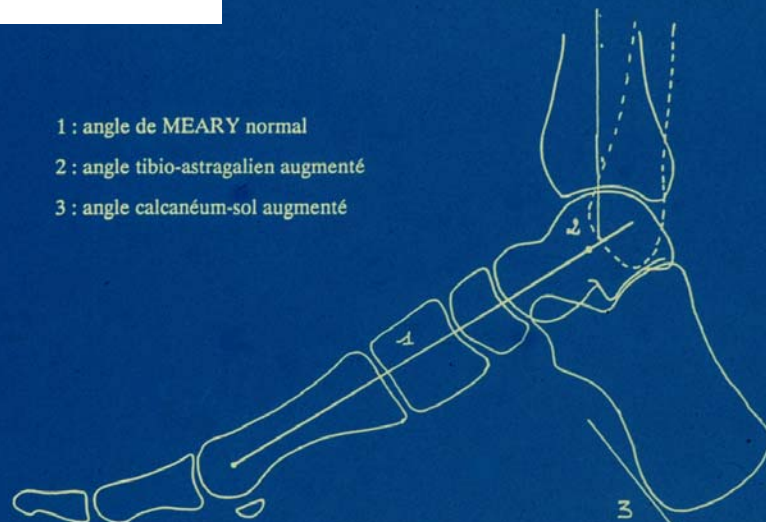


Posterior direct pes cavus

D CREUX DIRECT POSTERIEUR

Calcaneal incidence →

- 1 : angle de MEARY normal
- 2 : angle tibio-astragalien augmenté
- 3 : angle calcanéum-sol augmenté



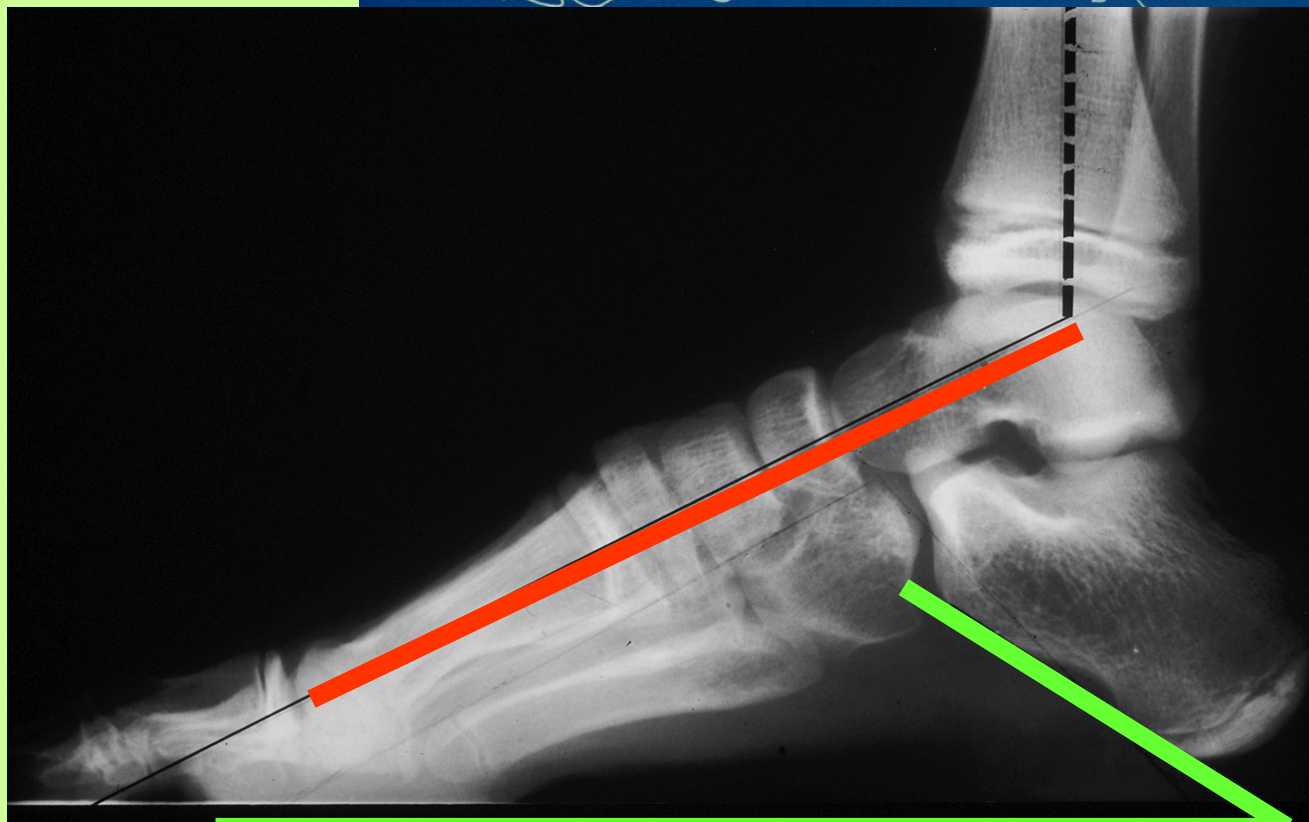
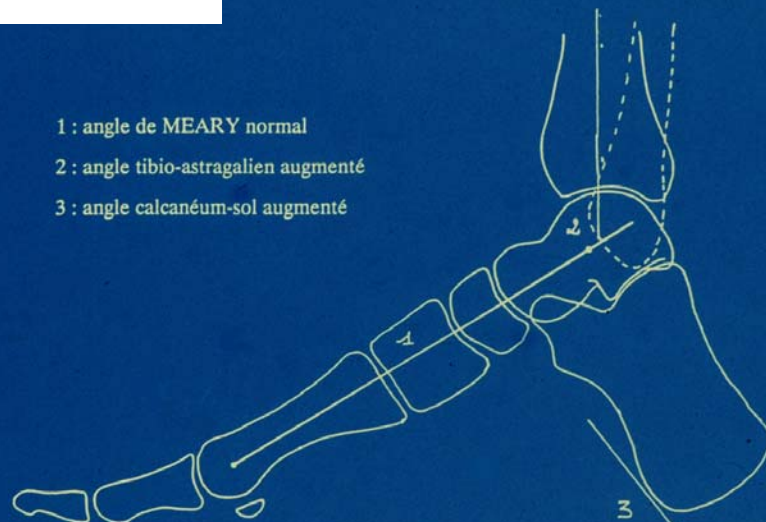
Posterior direct pes cavus

D CREUX DIRECT POSTERIEUR

Méary angle : normal

Calcaneal incidence ↗

- 1 : angle de MEARY normal
- 2 : angle tibio-astragalien augmenté
- 3 : angle calcanéum-sol augmenté



Posterior direct pes cavus

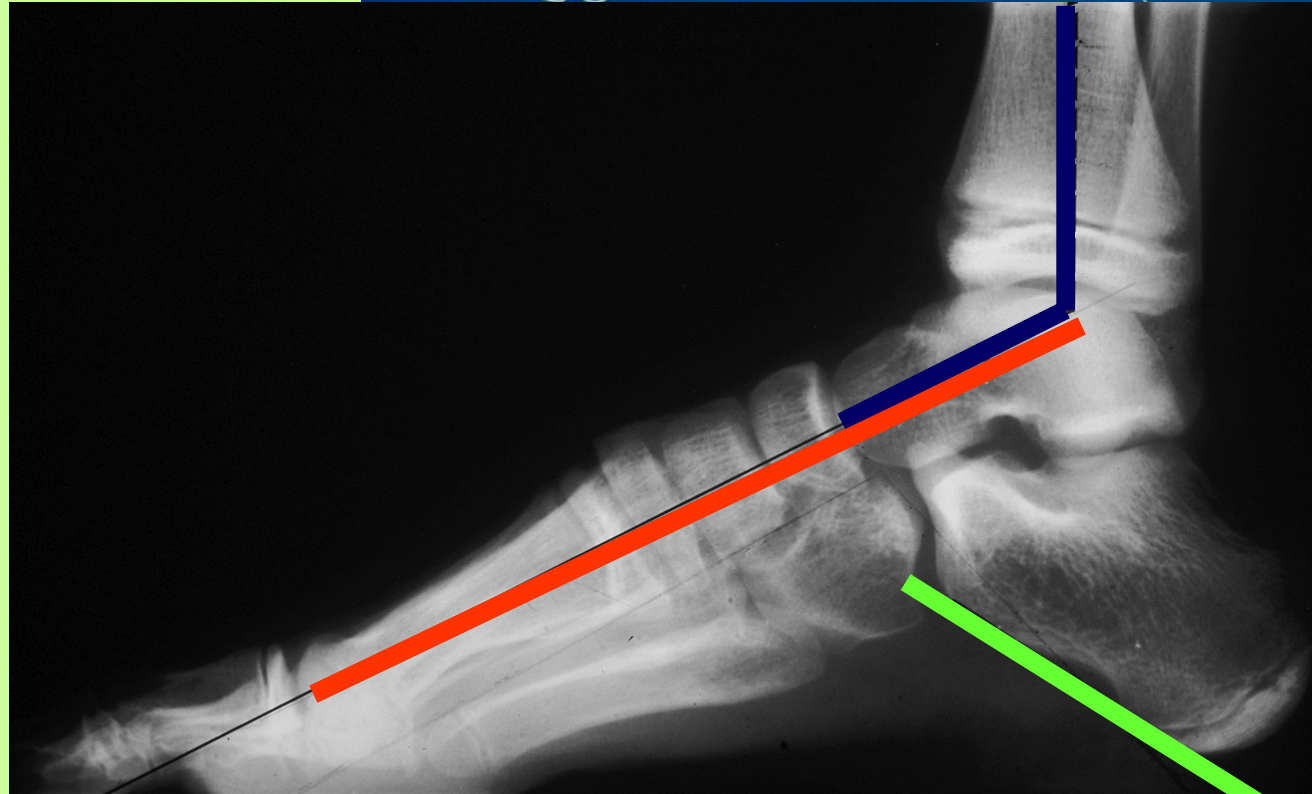
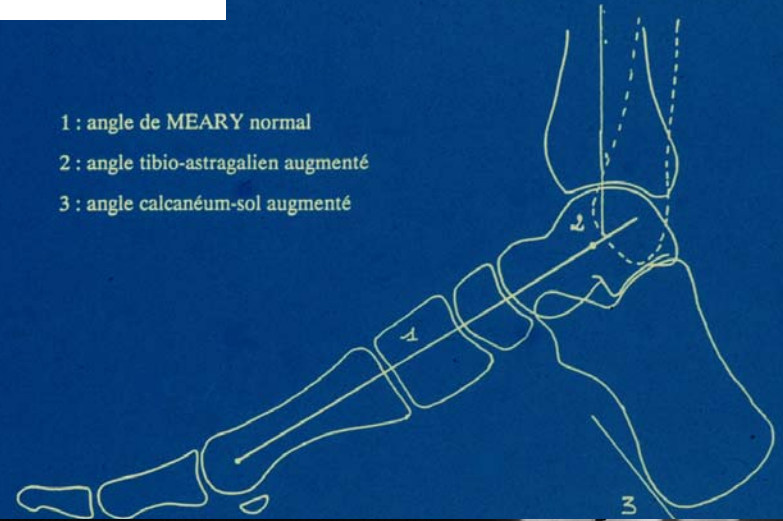
D CREUX DIRECT POSTERIEUR

Méary angle : normal

Tibio-talar angle 

Calcaneal incidence 

- 1 : angle de MEARY normal
- 2 : angle tibio-astragalien augmenté
- 3 : angle calcanéum-sol augmenté

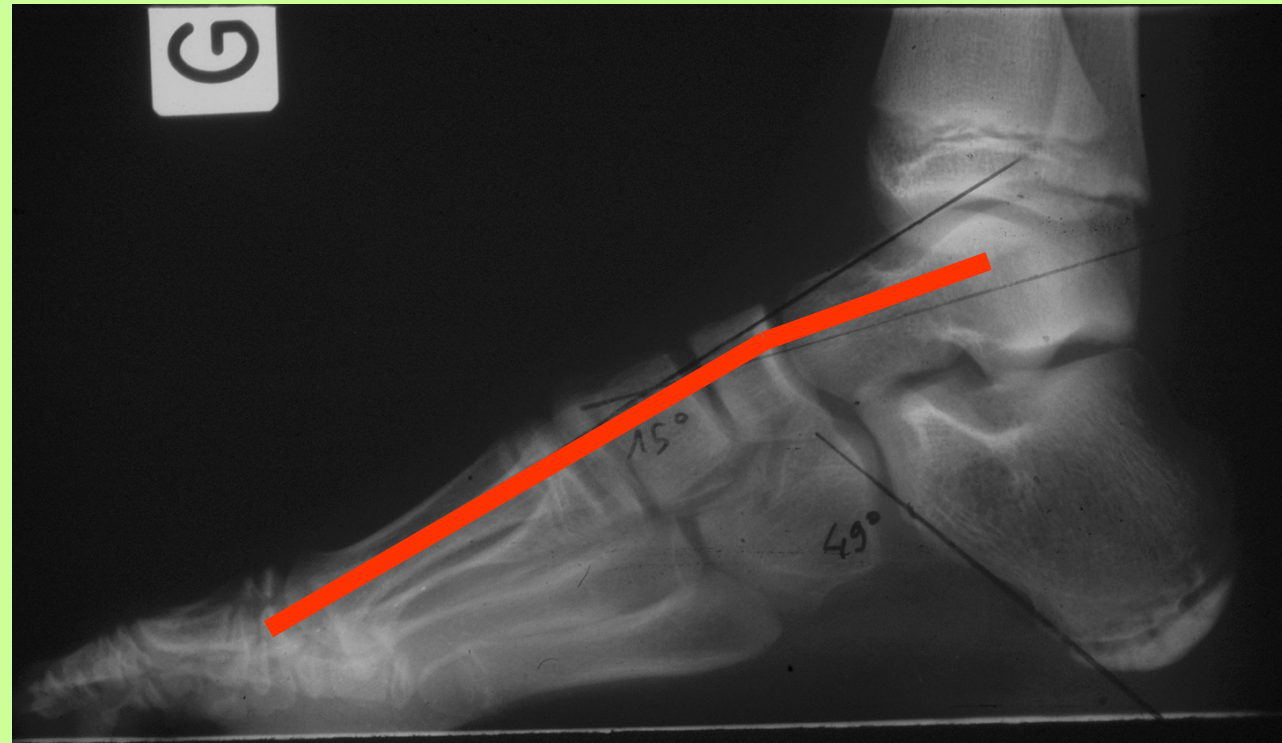
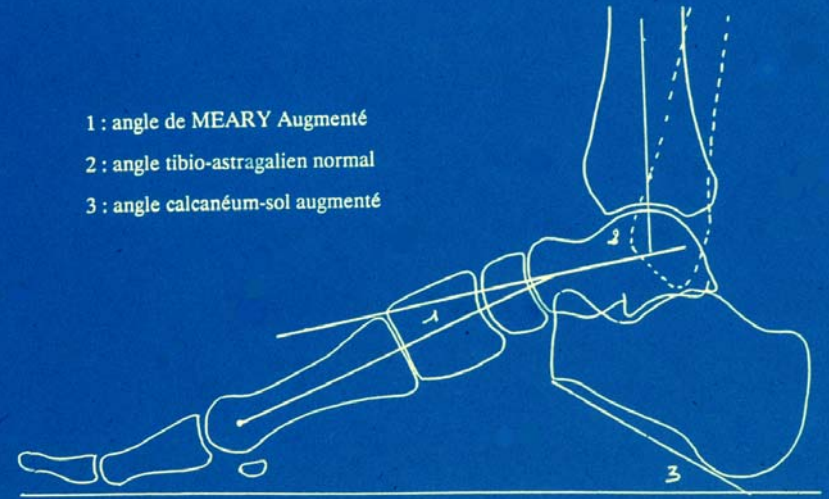


Combined direct pes cavus

PIED CREUX MIXTE

Méary angle 

- 1 : angle de MEARY Augmenté
- 2 : angle tibio-astragalien normal
- 3 : angle calcanéum-sol augmenté



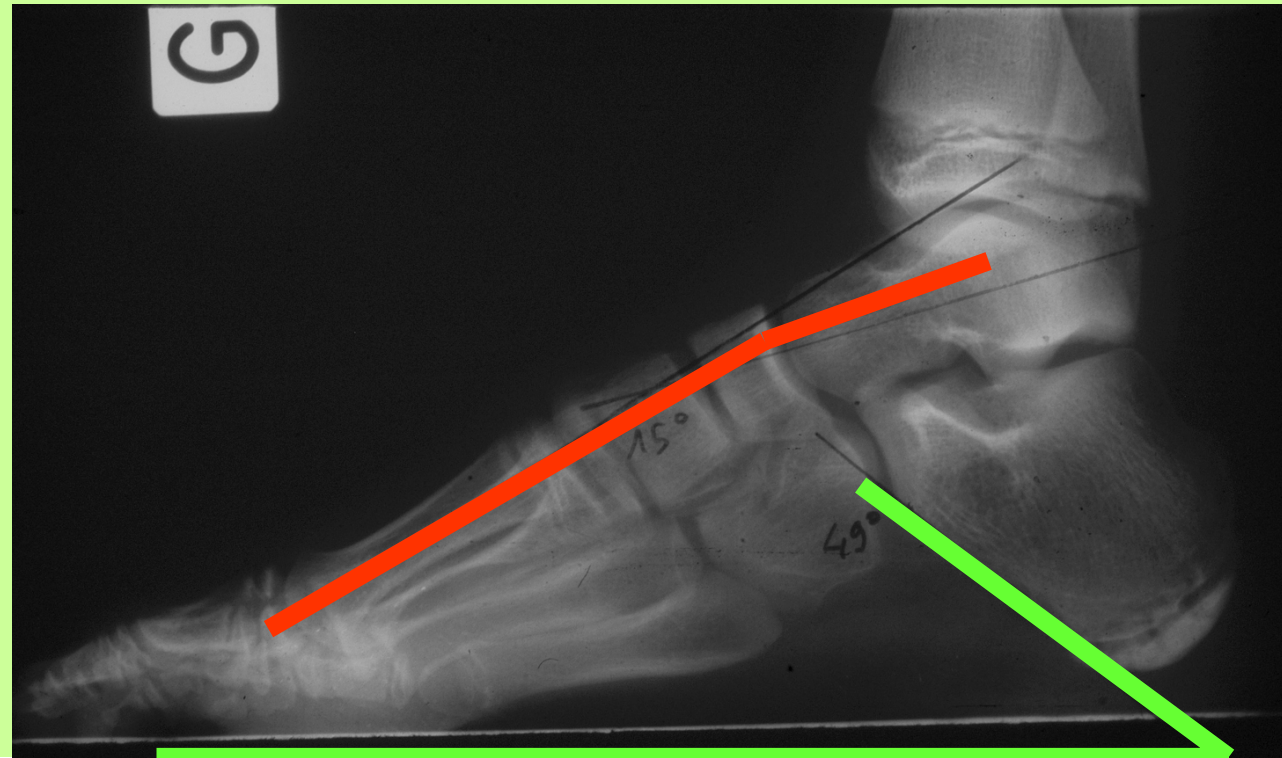
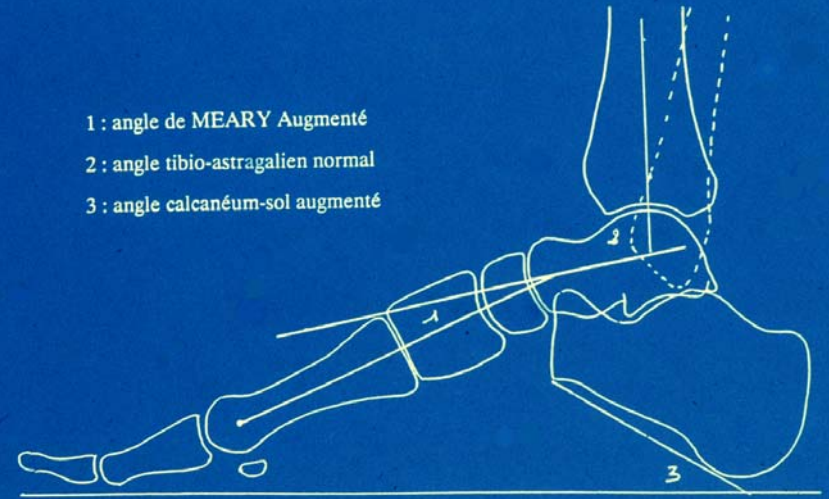
Combined direct pes cavus

PIED CREUX MIXTE

Méary angle 

Calcaneal incidence 

- 1 : angle de MEARY Augmenté
- 2 : angle tibio-astragalien normal
- 3 : angle calcanéum-sol augmenté



Combined direct pes cavus

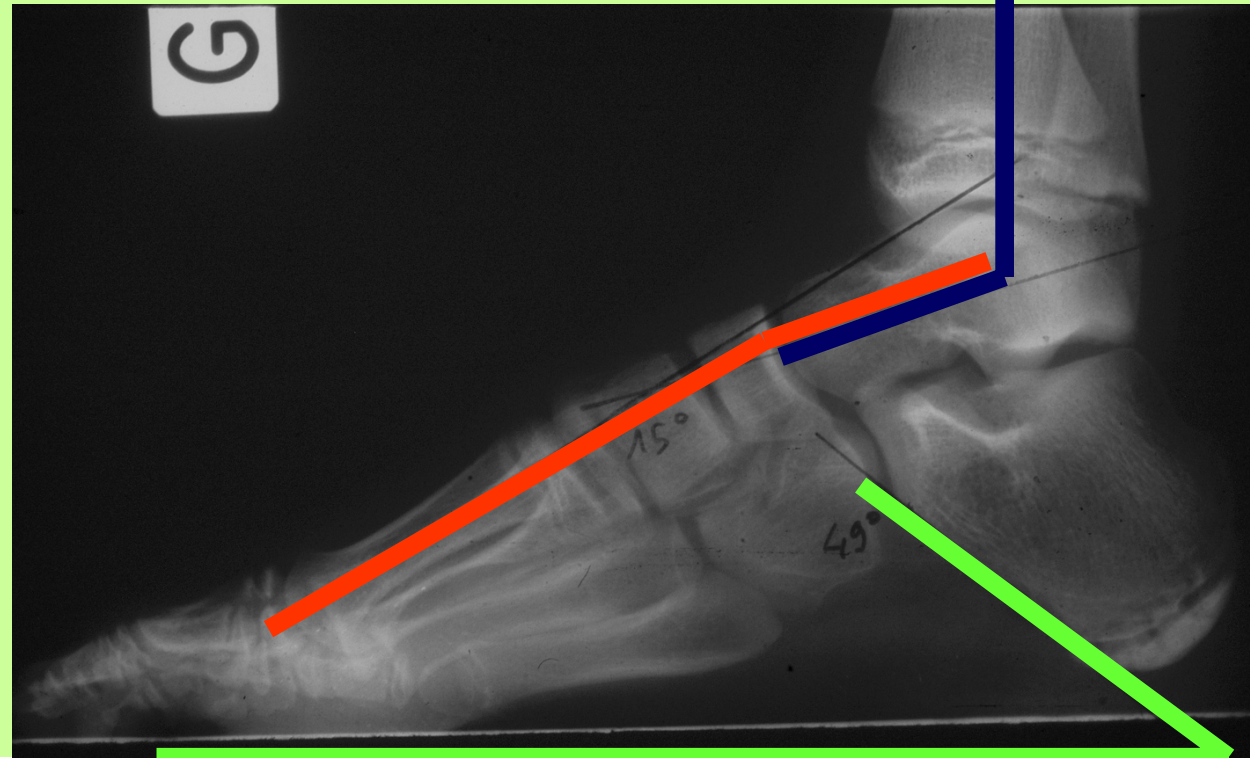
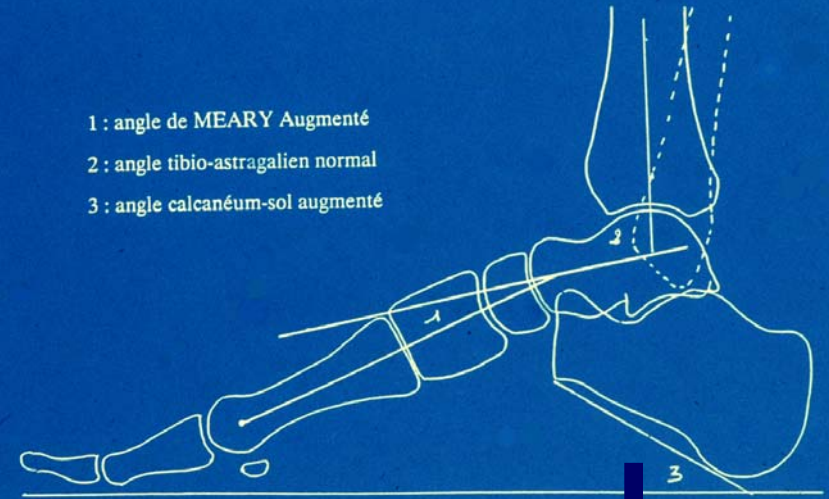
PIED CREUX MIXTE

Méary angle 

Tibio-talar angle : normal

Calcaneal incidence 

- 1 : angle de MEARY Augmenté
- 2 : angle tibio-astragalien normal
- 3 : angle calcanéum-sol augmenté



Etiologies of posterior direct cavus foot

1 - Neurologic (Triceps surae palsy)

- polio
- spina bifida

2 - Tricipital insufficiency after TAL

Clubfoot

Cerebral palsy

3 – Syndromic feet

- Marfan
- etc

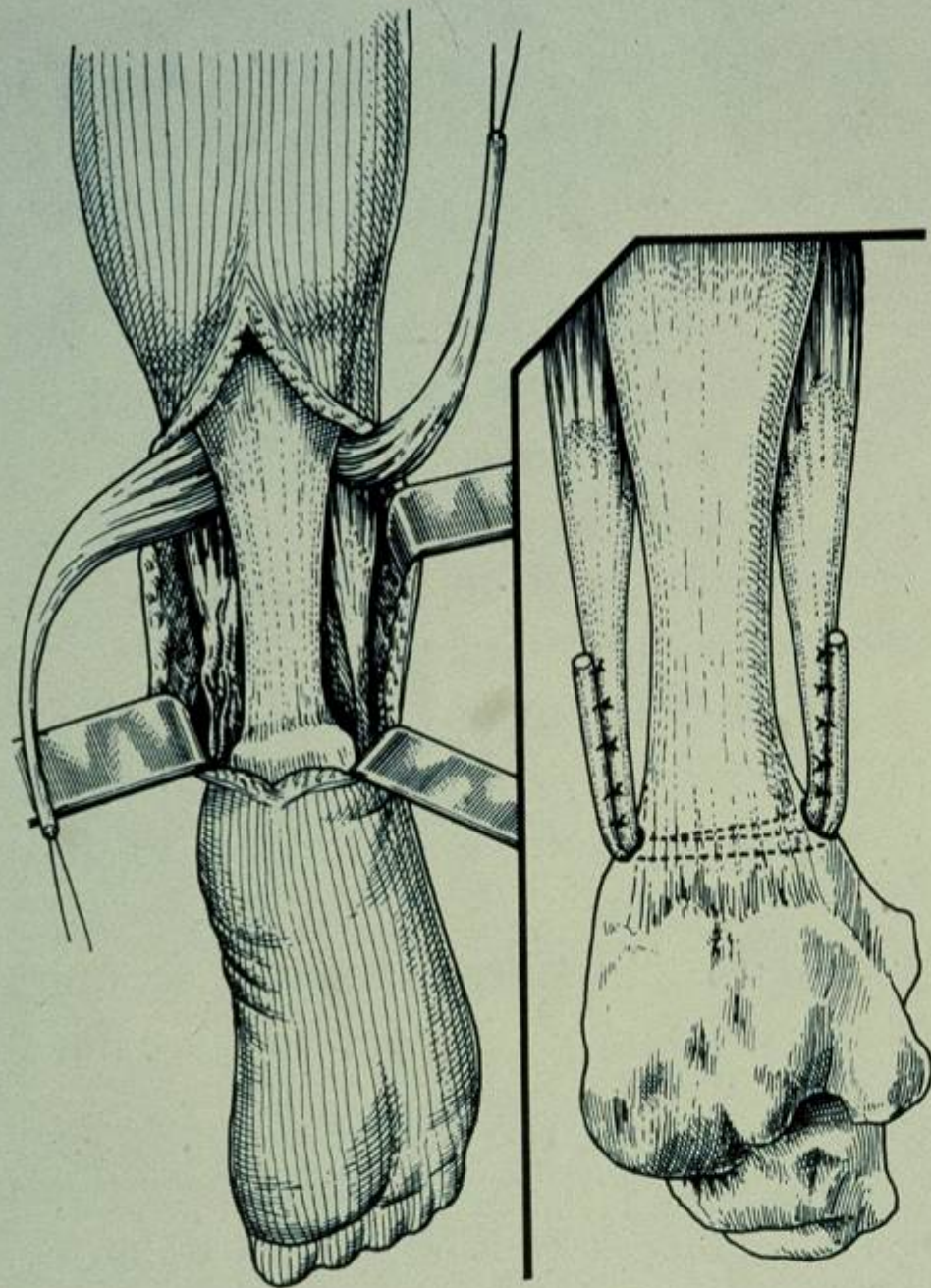


Treatment of posterior direct cavus foot

Osteotomy of the calcaneum

Muscle transfer : Ant Tib and/or extensor and/or third fibular muscle on triceps surae tendon

At the end of growth : **triple arthodesis**



a

b

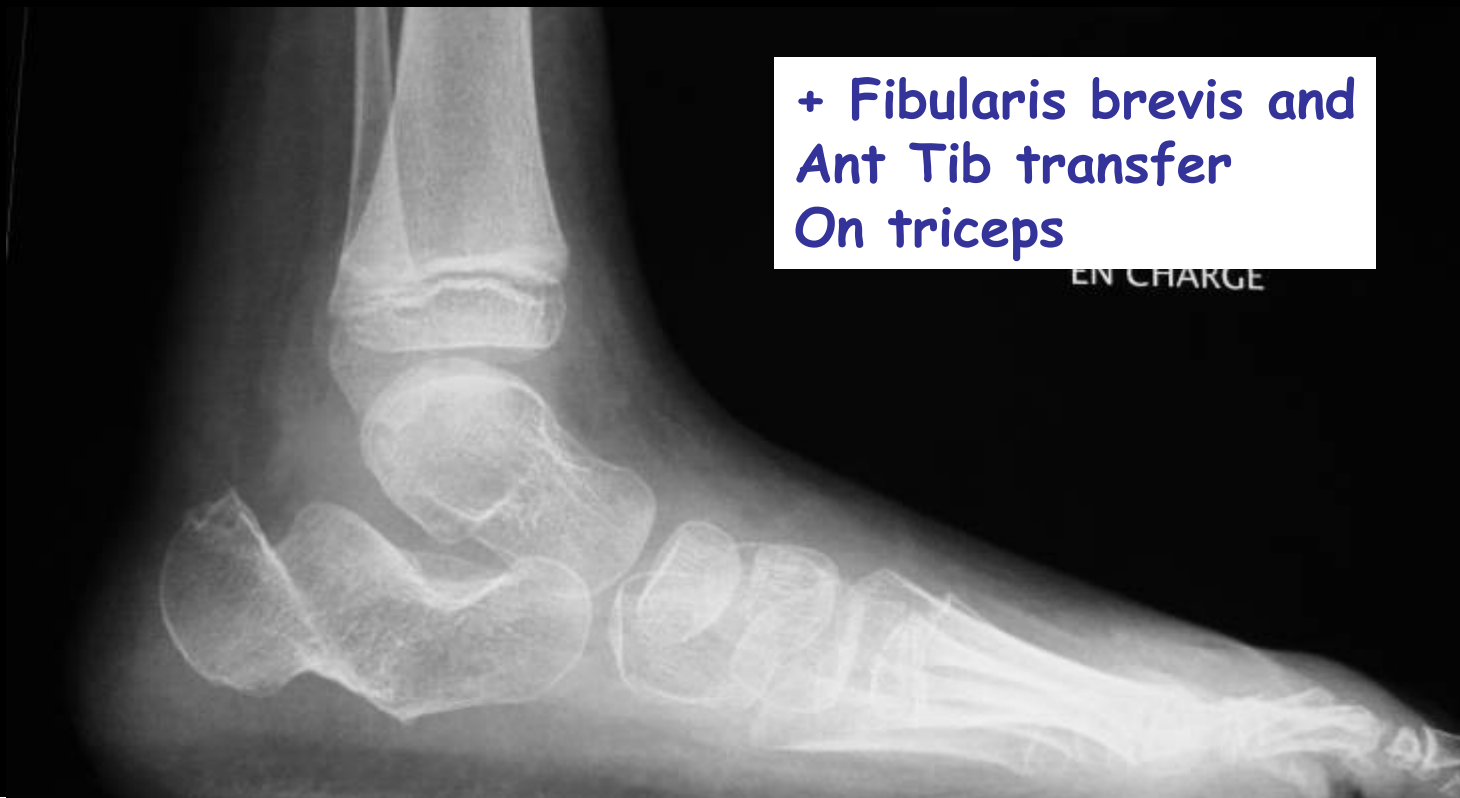
FIG. 632 et 633. — *Transfert en arrière
du court péronier latéral
et du jambier postérieur.*

FIG. 632. — *Installation de l'opéré et
tracé de 2 des 3 incisions (celle du
prélèvement du jambier postérieur
n'est pas visible).*

FIG. 633. — *a) Les deux tendons sont
amenés dans l'incision postérieure.
b) Schéma de leur fixation après pas-
sage dans un tunnel transcalcaneén.*

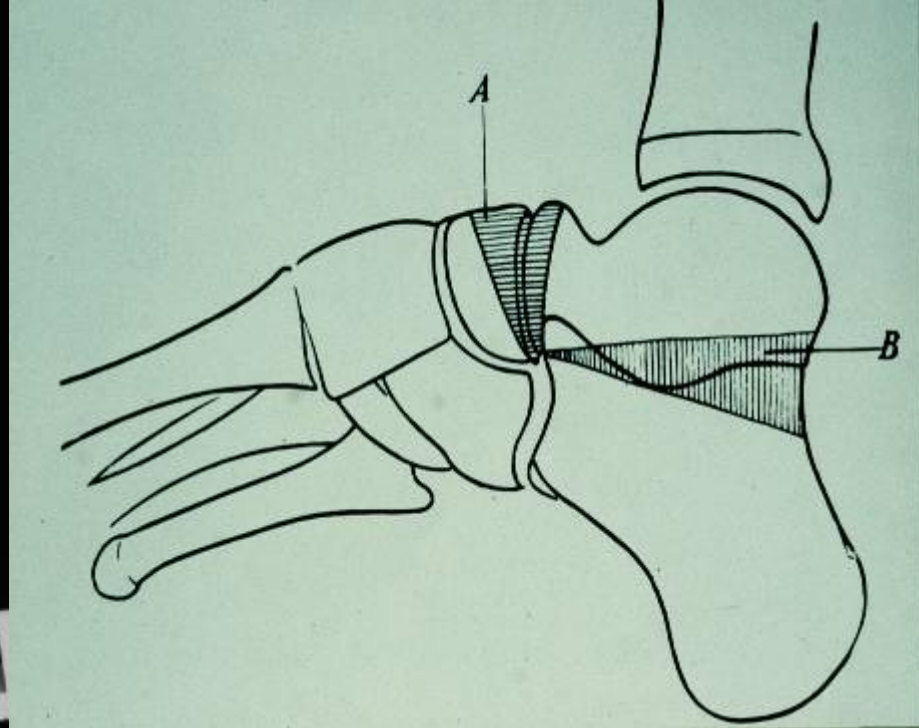


Boy, 7 yo
Sciatic nerve palsy
Unknown etiology

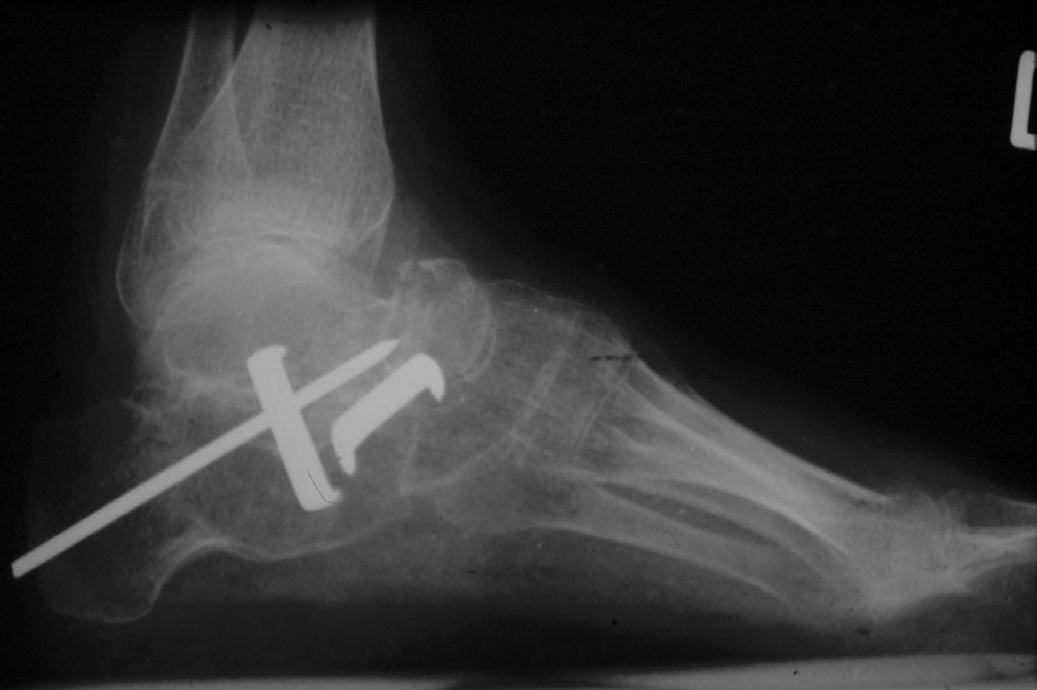


+ Fibularis brevis and
Ant Tib transfer
On triceps

EN CHARGE



+ Triple arthrodesis



Spina bifida



Spina bifida

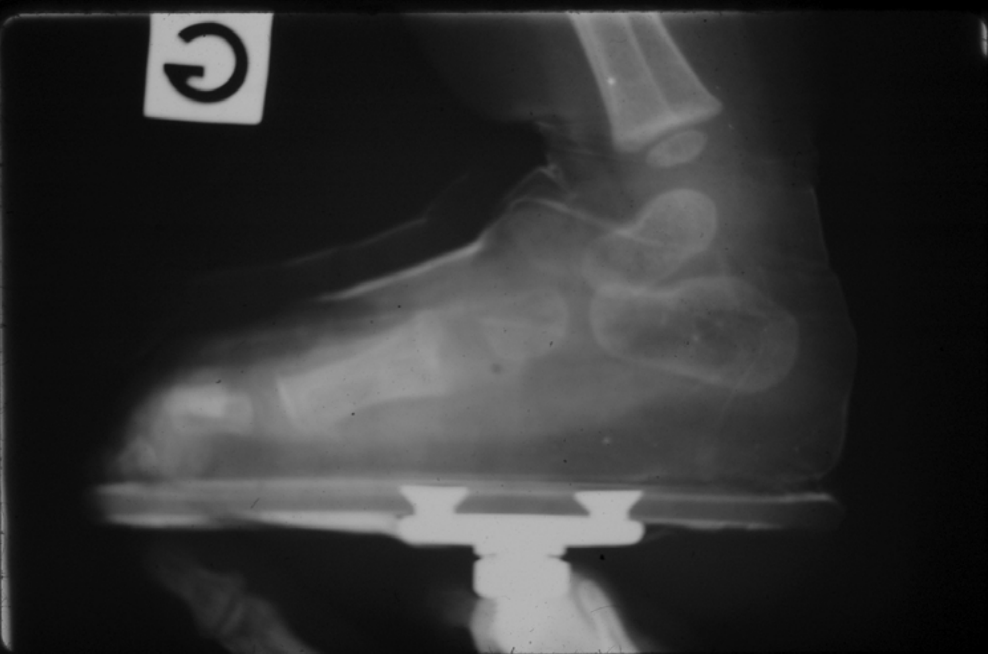
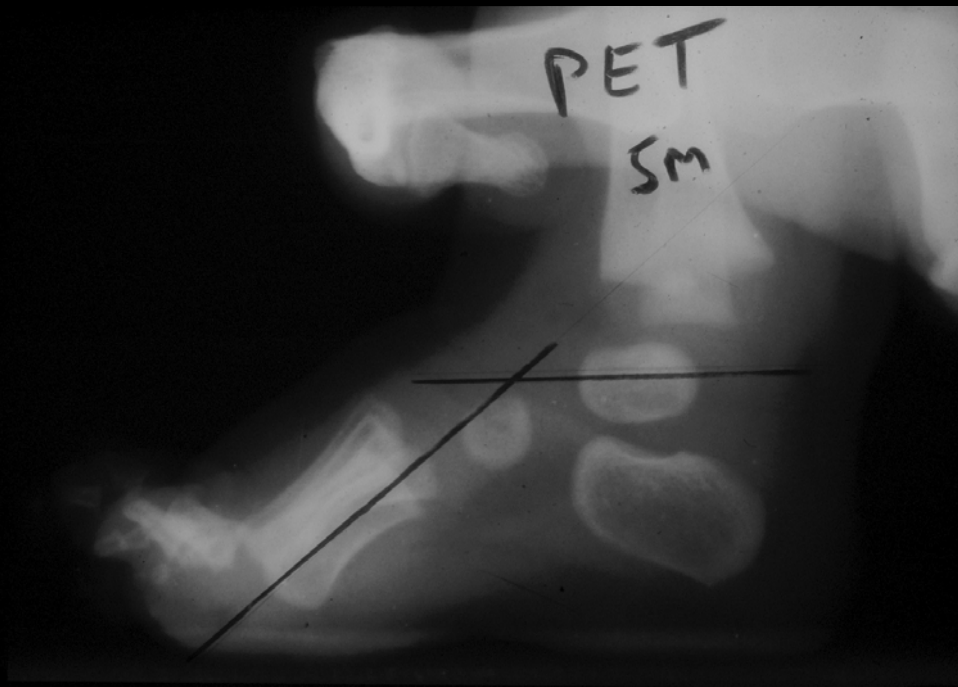


Marfan syndrome



Marfan syndrome





Congenital pes cavus

Pes cavo-varus

Claw toes

Irreducible mid/fore-foot pronation

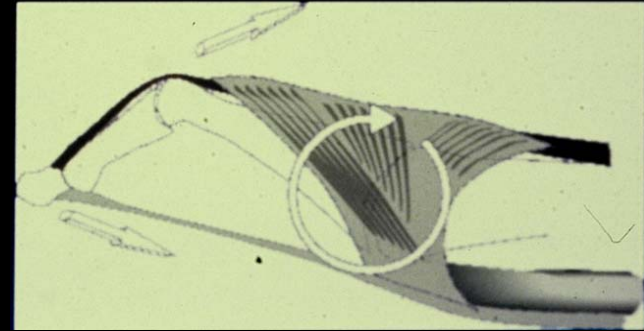
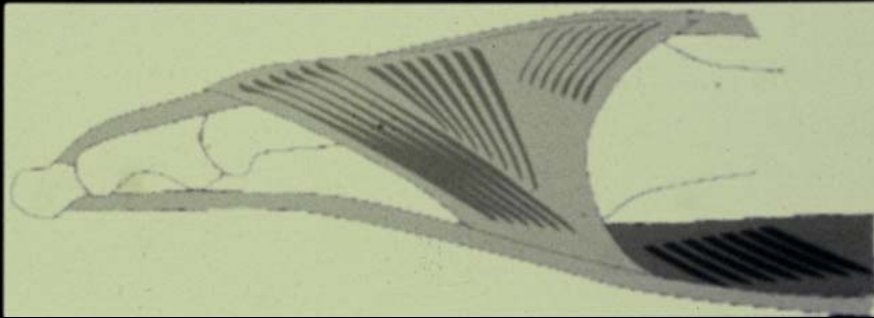
Structural deformation of cuneiform bones

Medial cavus

Neurologic etiology



Intrinsic muscle palsy



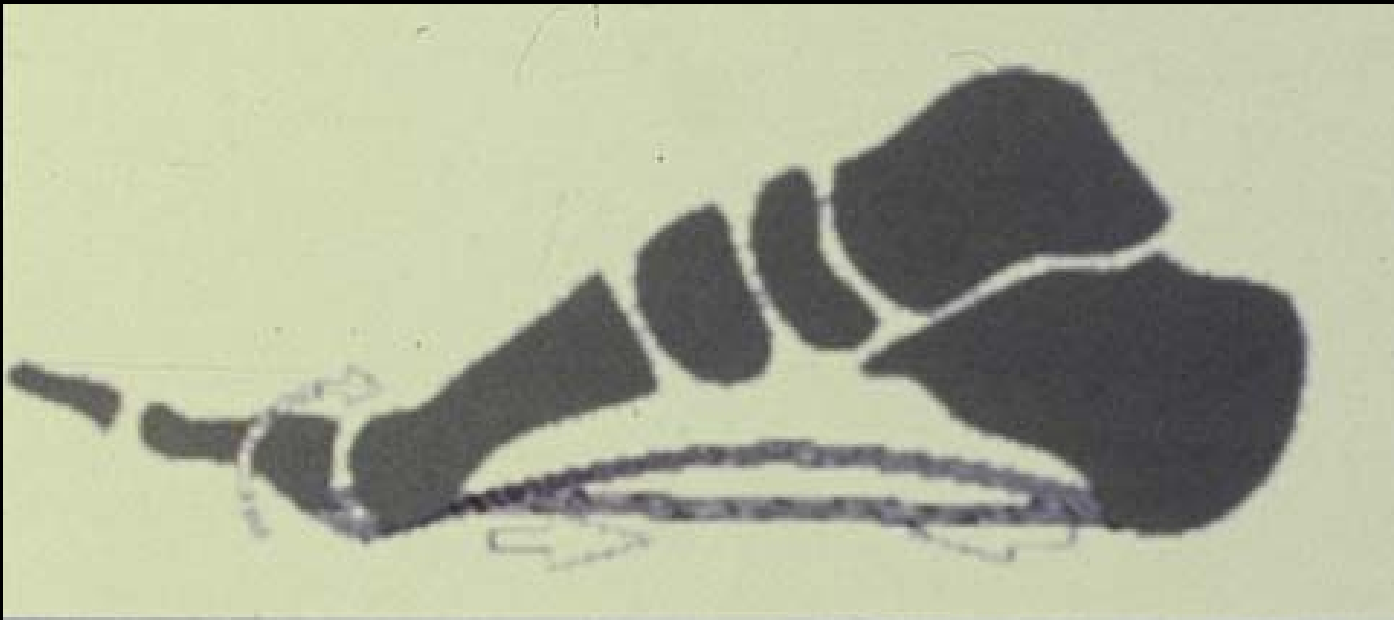
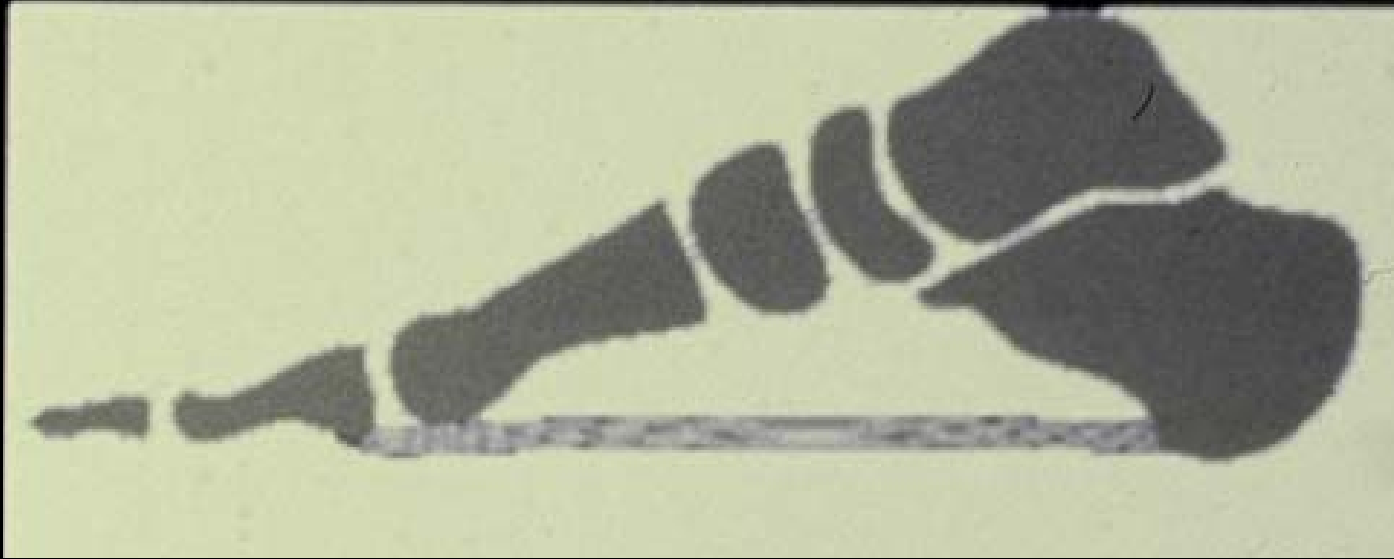
Intrinsic muscle activity is mandatory for active toes and ankle extension

Palsy of intrinsic muscles induces

- Metatarsophalangeal joint extension**
- Compensatory inter-phalangeal joints flexion**

= Claw toes

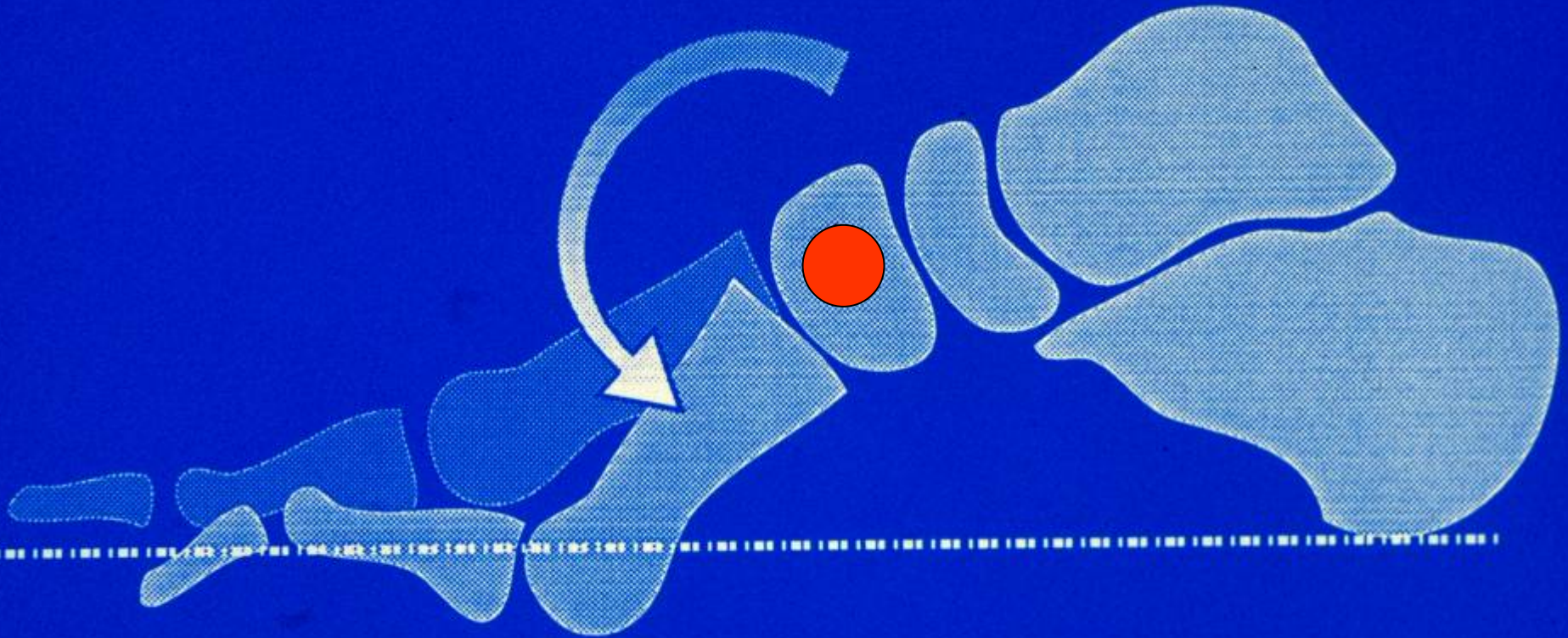
Role of plantar aponeurosis



Apex of the cavus

=

Cuneiform bones

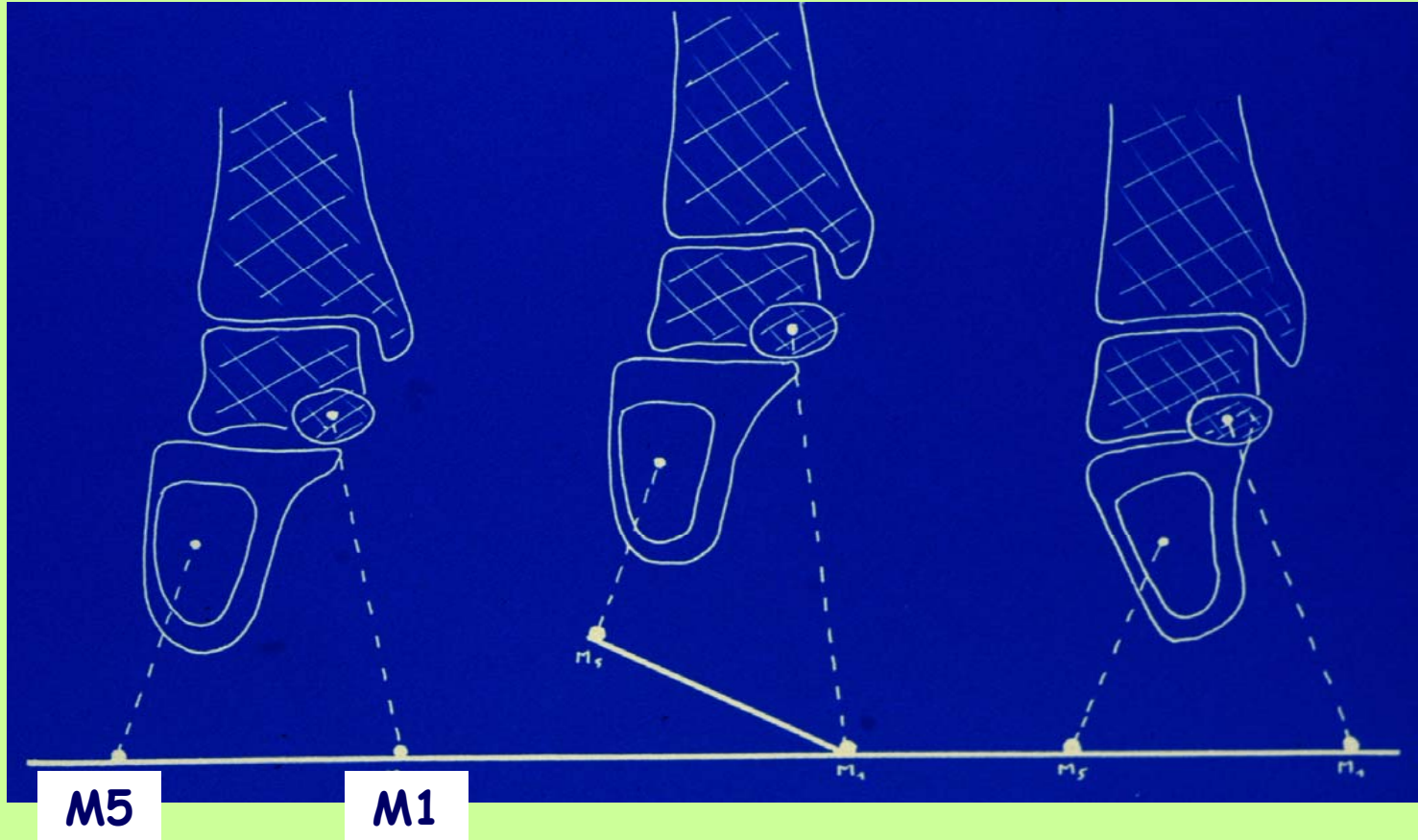


Irreducible mid/fore-foot pronation

induces

Supination of calcaneo-pedal block with Heel varus

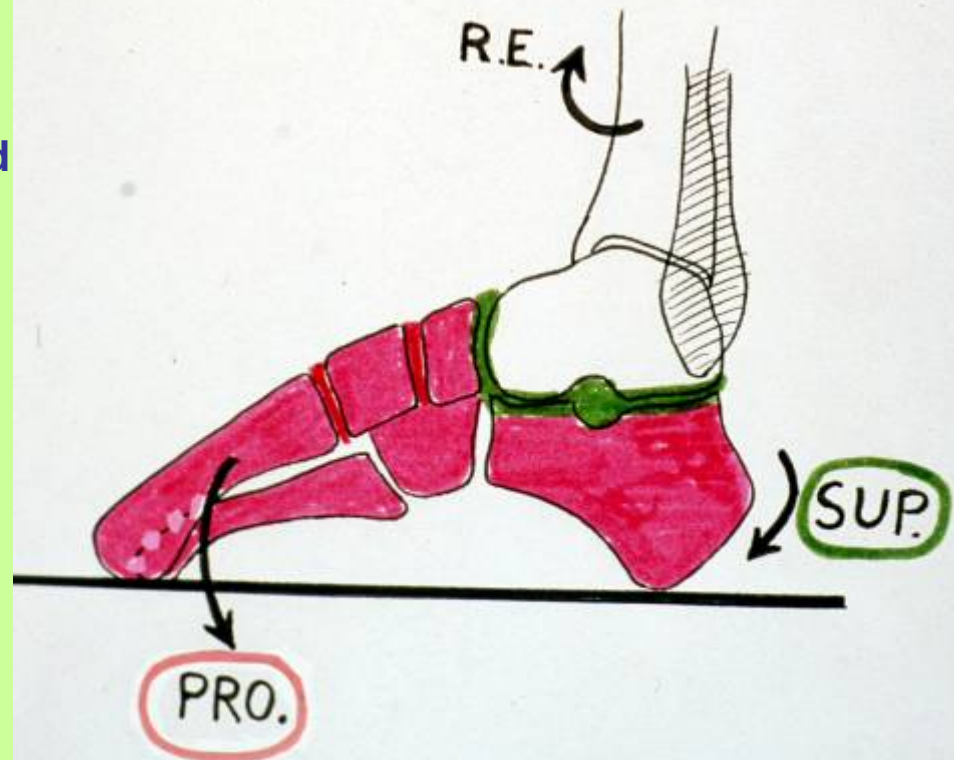
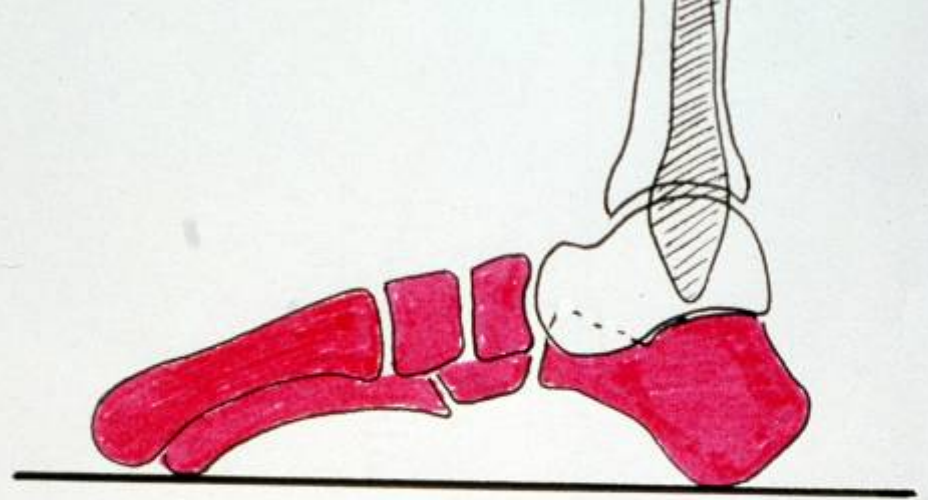
Tripod support theory



Pes cavo-varus

The calcaneo-pedal block is twisted

The talo-tibio-fibular unit is externally rotated



Supination of the calcaneo-pedal block

Induces

Abduction of the talus

(external rotation of the talo-tibio-fibular unit)



Charcot Marie Tooth disease

Pes planus valgus
(3 years old)



Pes cavo-varus



Test of walk on heels (evaluation des intrinsec muscles)

Normal child



Test of walk on heels (evaluation des intrinsec muscles)

Normal child

CMT disease

Pes cavo varus : early stage

CMT disease

12 yo



12 yo



16 yo

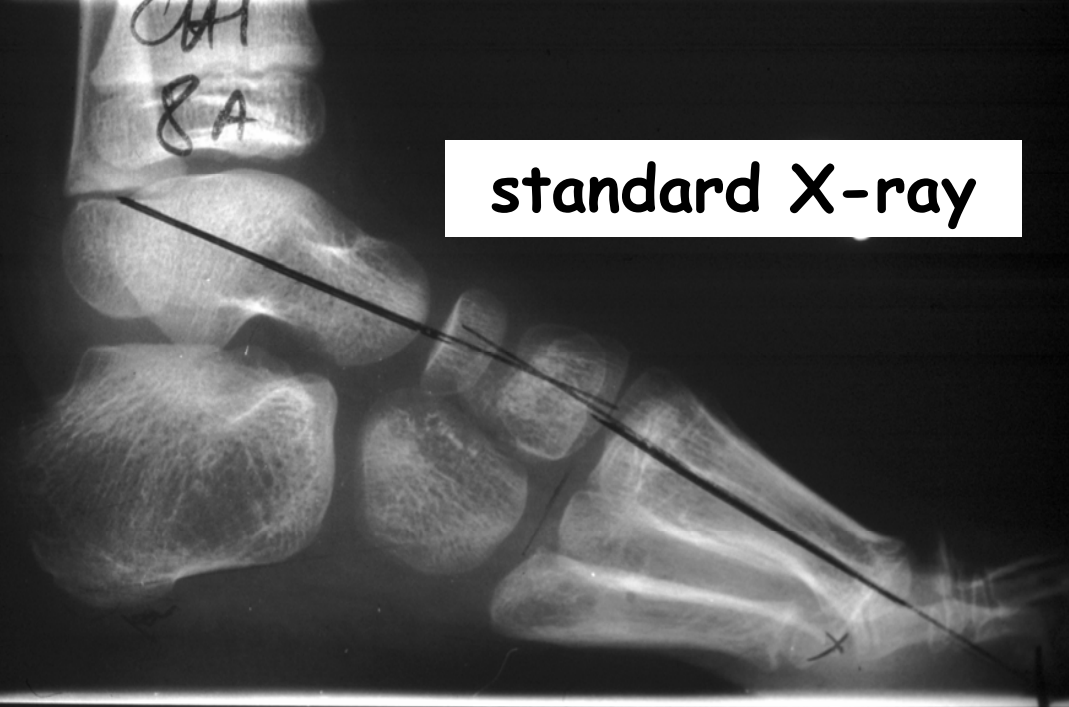


X-rays under-estimate the cavus

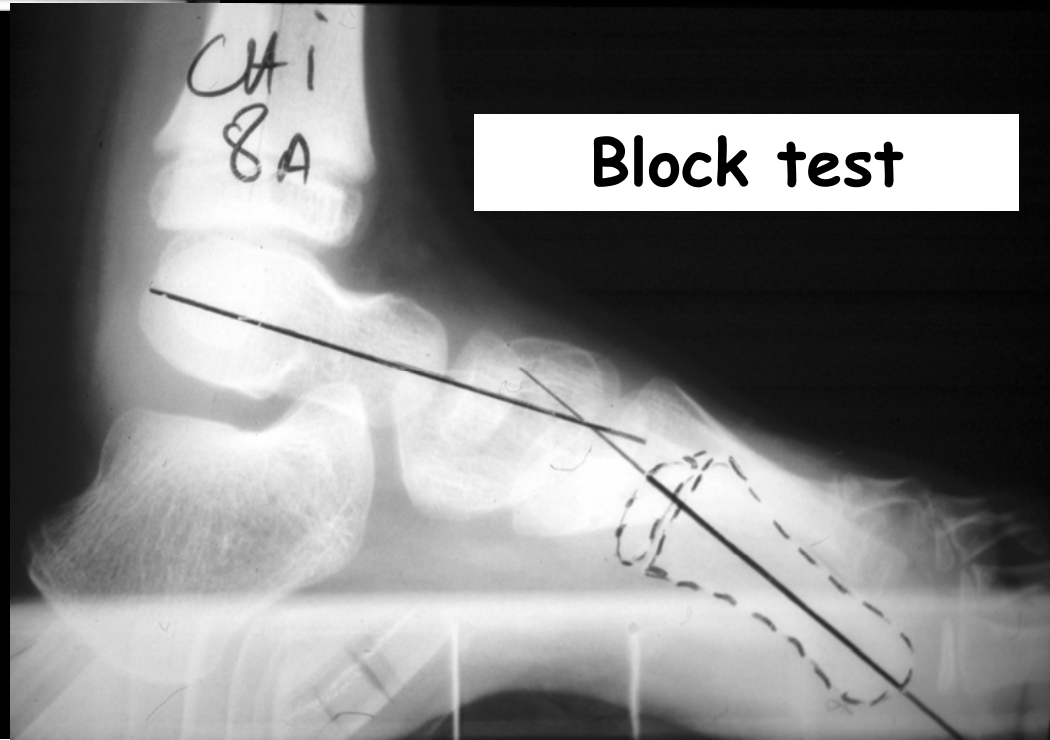
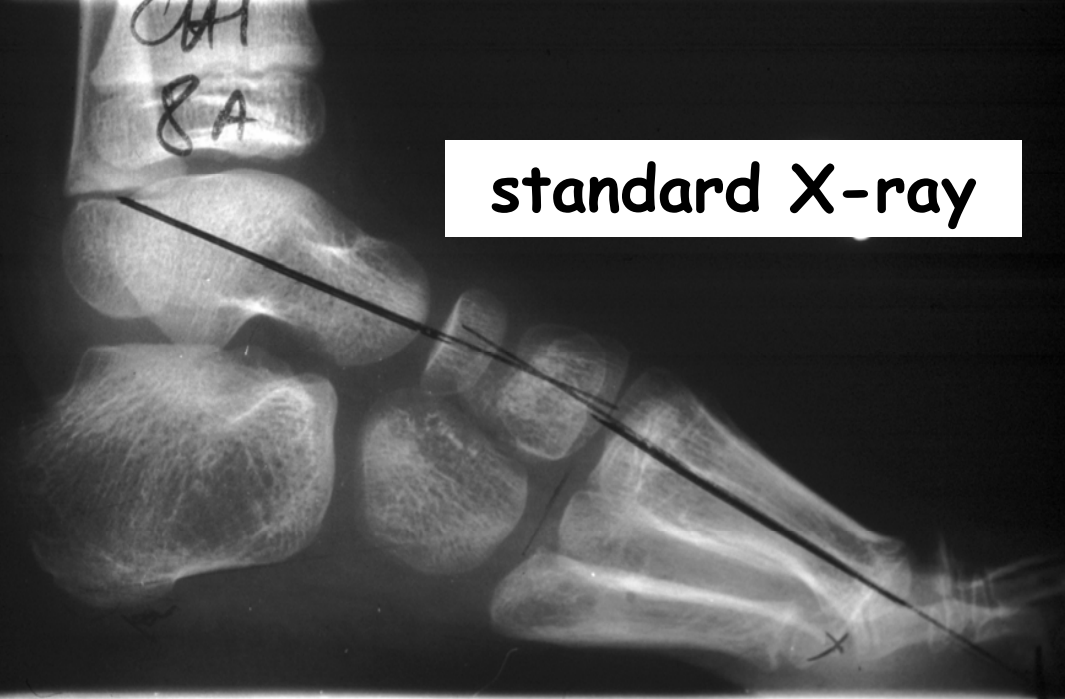


Block Test

Reduces the transversal desordres
External rotation of talo-tibio-fibilar unit



standard X-ray



Flexibility of transversal disorders

standard X-ray



Flexibility of transversal desordres

standard X-ray



Block test



Cavus and claw toes

Worsen

In decubitus !!!

Treatment



« Pes cavovarus is a challenging deformity to treat during childhood »

Mosca VS. JPO 2001 ; 21 : 423 - 424

Precocious complaints during childhood

- Ankle sprains
- Painful callosities under the head of M1 and the base of M5

Soft tissue release

Steindler. J Orthop Surg. 1920 ; 2 : 8
Paulos et al. JBJS Am 1980 ; 62A : 942
Sherman and Westin. JBJS Am 1981 ; 63 : 1382
Larivière et al. Rev Chir Orthop. 1985 ; 71 : 563
Roper and Tibrewal SB. JBJS Br ; 1989 ; 71 : 17

Muscular transfers

Azmaipairashvili et al. JPO, 2005 ; 25 : 360

Osteotomies

Japas. JBJS 1968 ; 50 Am : 927
Dekel and Weissman. JBJS Br 1973 ; 55 : 802
Méary et al. Rev Chir Orthop. 1976 ; 62 : 231
Jahss. JBJS Am 1980 ; 62 : 713
Wilcox and Weiner. JPO 1985 ; 5 : 333
Alexander and Johnson. Clin Orthop 1989 ; 246 : 273
Watanabe. Clin Orthop 1990 ; 252 : 217
Sammarco and Taylor. Foot Ankle Clin. 2001 ; 6 : 533

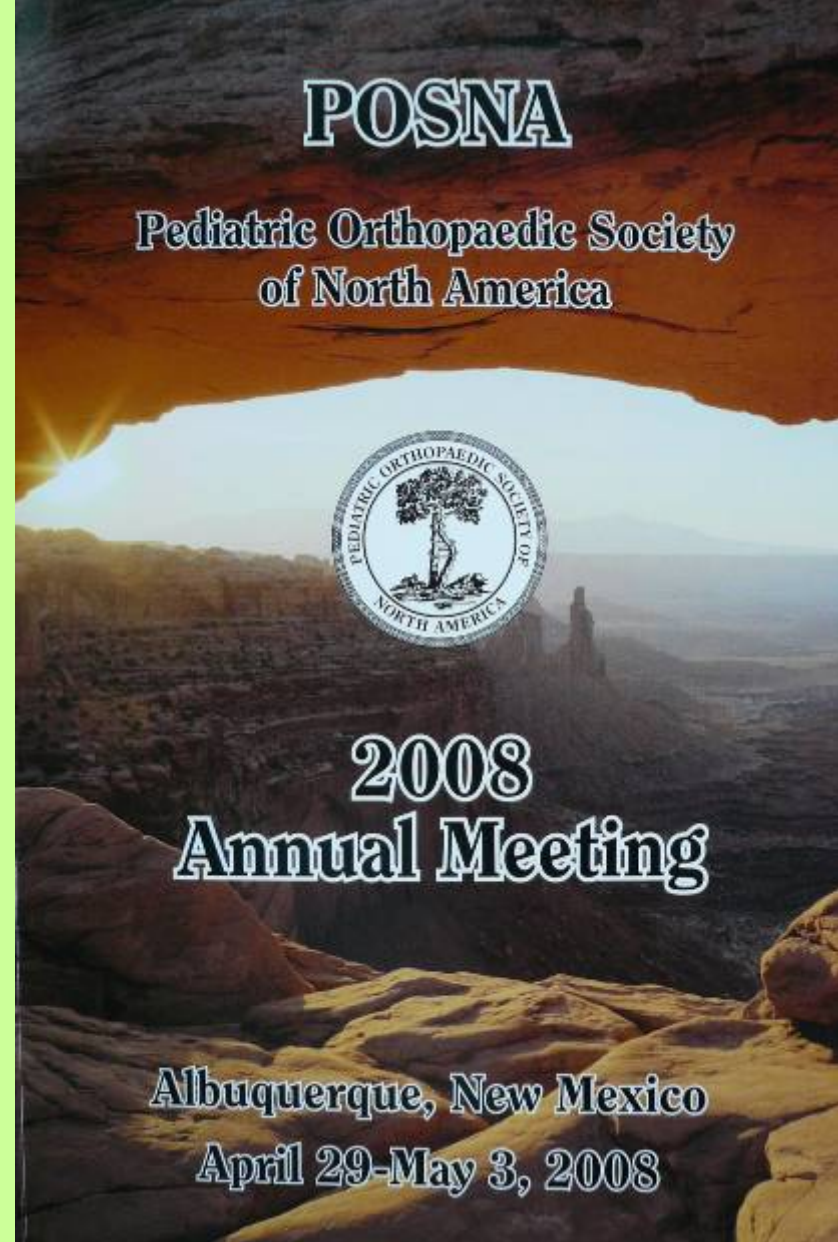
No ideal treatment

- High frequency of recurrence
- Not adequate for children during growth
- Induced rigidity

Traditional treatment

Orthopedic treatment « Few, if any »

V. Mosca, POSNA, avril 2008



Triple arthrodesis at the end of growth

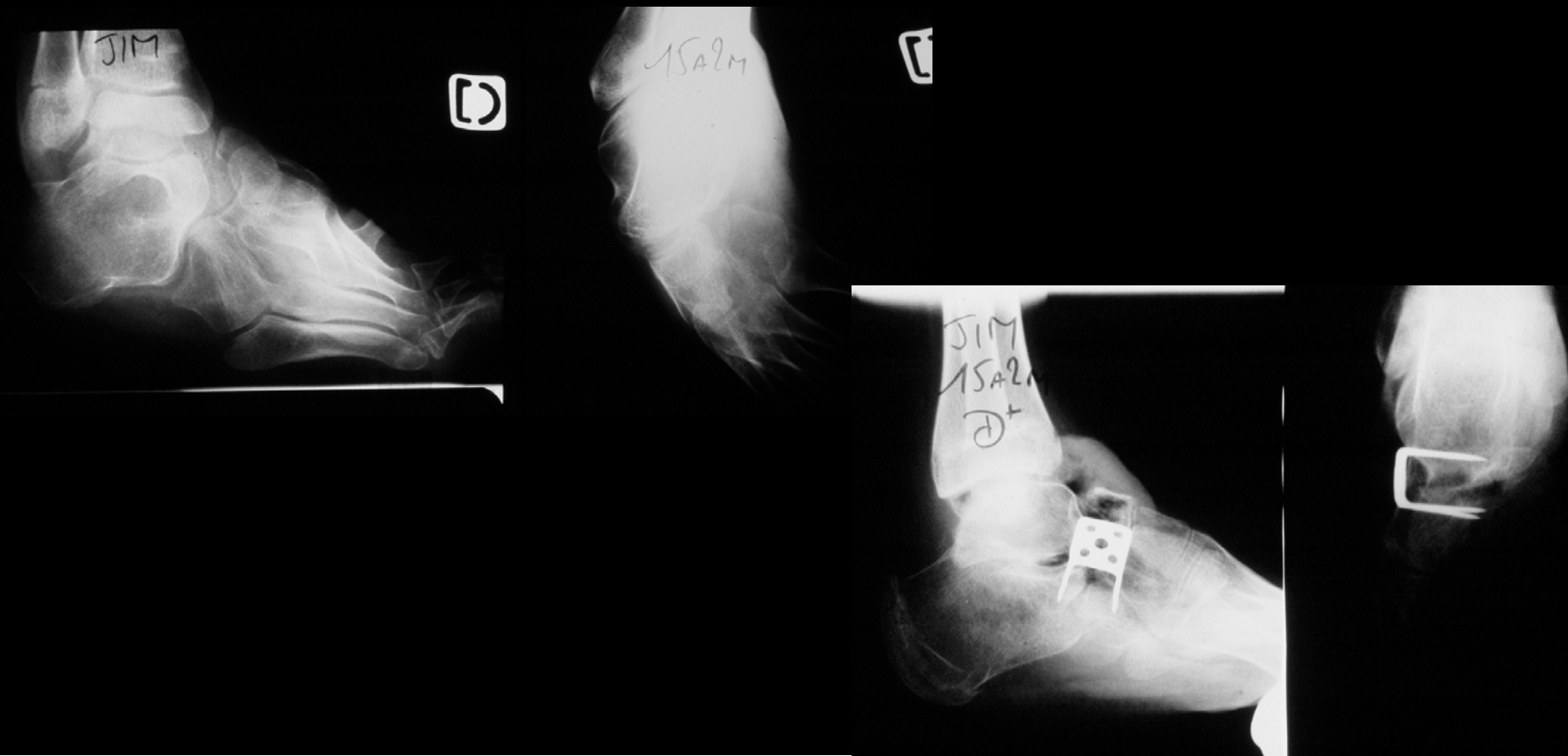
CMT

Neglected cavus feet (15 yo)

Huge deformations

Do not correct the deformity at its apex

Difficult triple arthrodesis with non satisfactory result



34
35
36
23
24



7 years later

Always needs orthopedic shoes

**Is triple arthrodesis at the end of growth
should be considered as the solution ?**

NO

**It does not solve the problem in young children
(6 to 12 ans)**

Ankle arthritis

Adelaar et al. Orthop Clin North Am. 1976 ; 7 : 895

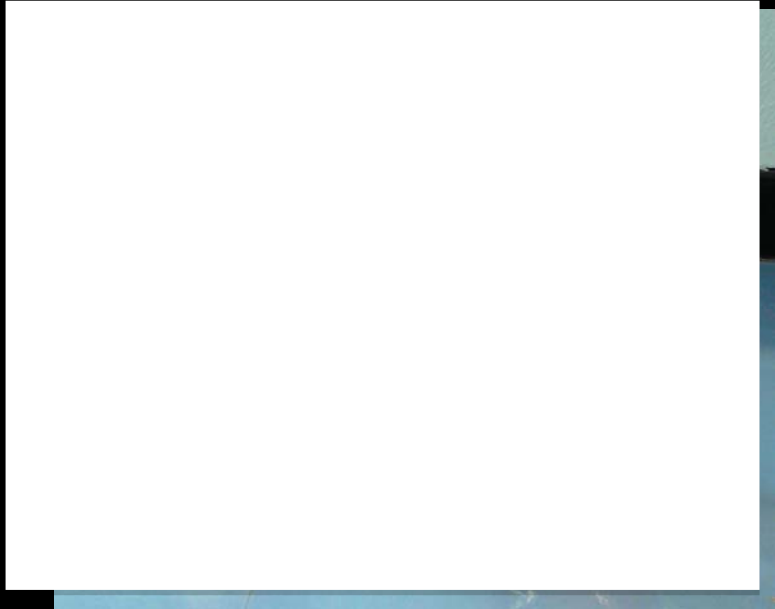
Wetmore and Drennan. JBJS Am 1989 ; 71 : 417

Wukich and Bowen. JPO 1989 ; 9 : 433

Ankle Charcot Arthropathy

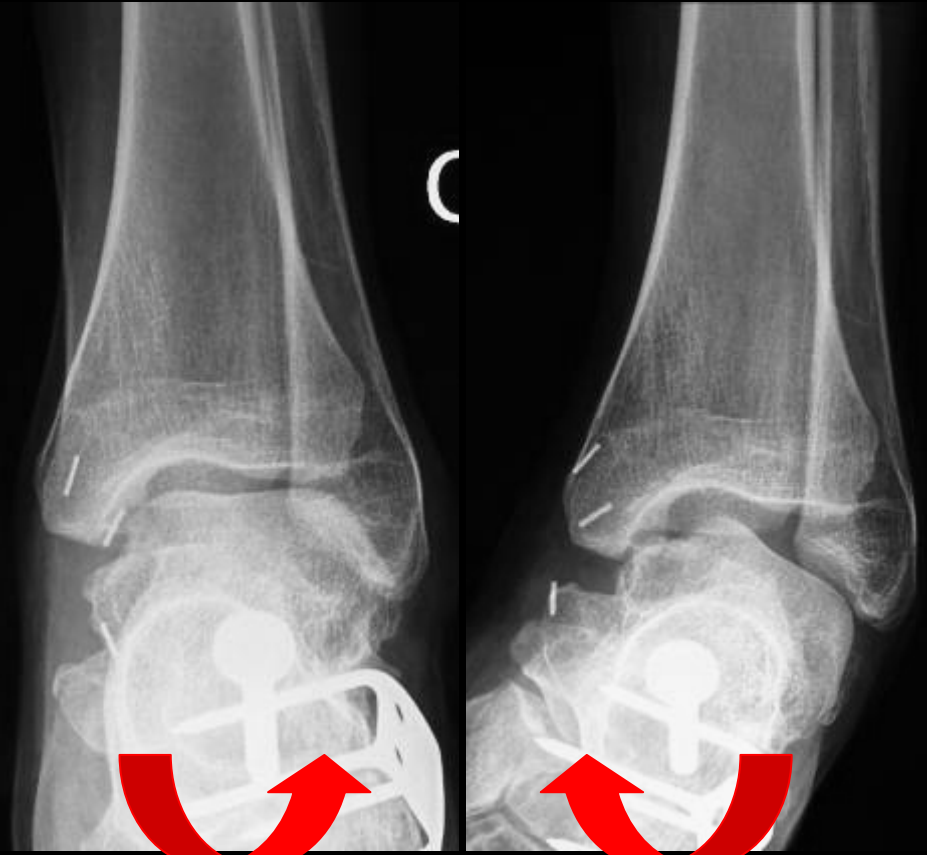
Medhat and Krantz. Orthop Rev. 1988 ; 17 : 873

Women, 29 yo, CMT
Triple arthrodesis at age 15



Antero-lateral ankle pain !!!

Women, 29 yo, CMT
Triple arthrodesis at age 15



Ankle instability

Antero-lateral ankle pain !!!

**Man, CMT disease
50 years old**



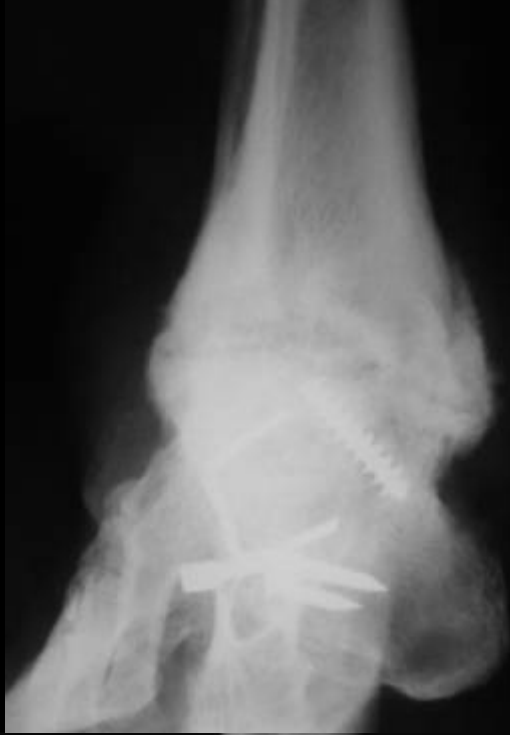
**Man, CMT disease
50 years old**

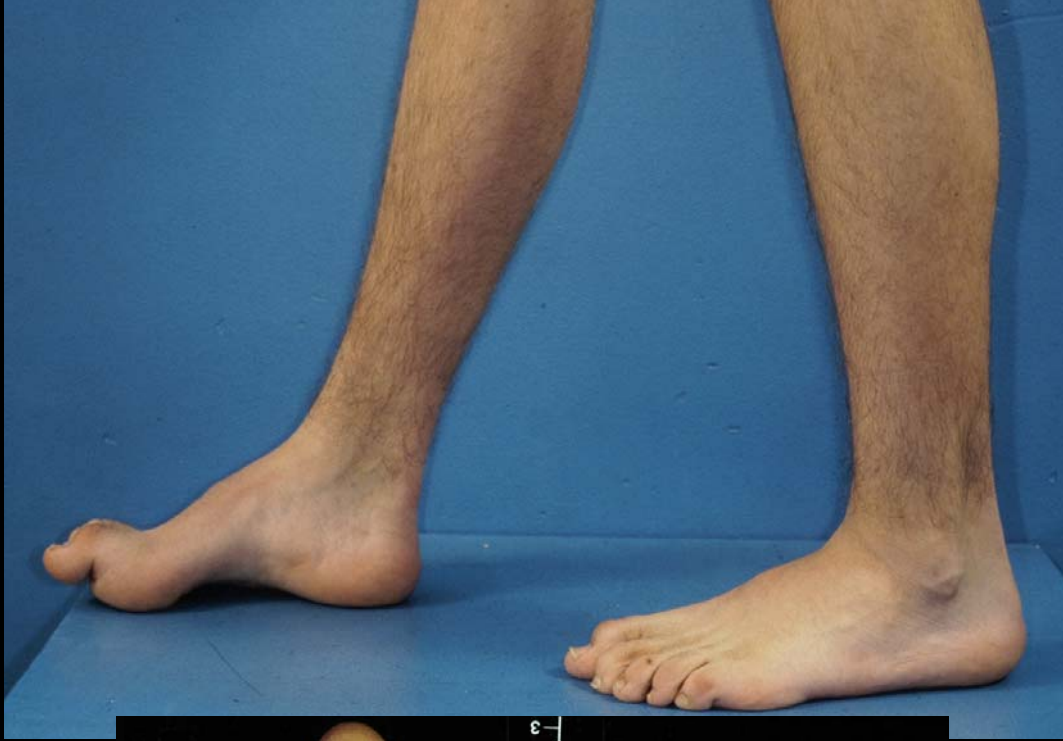


55 years old



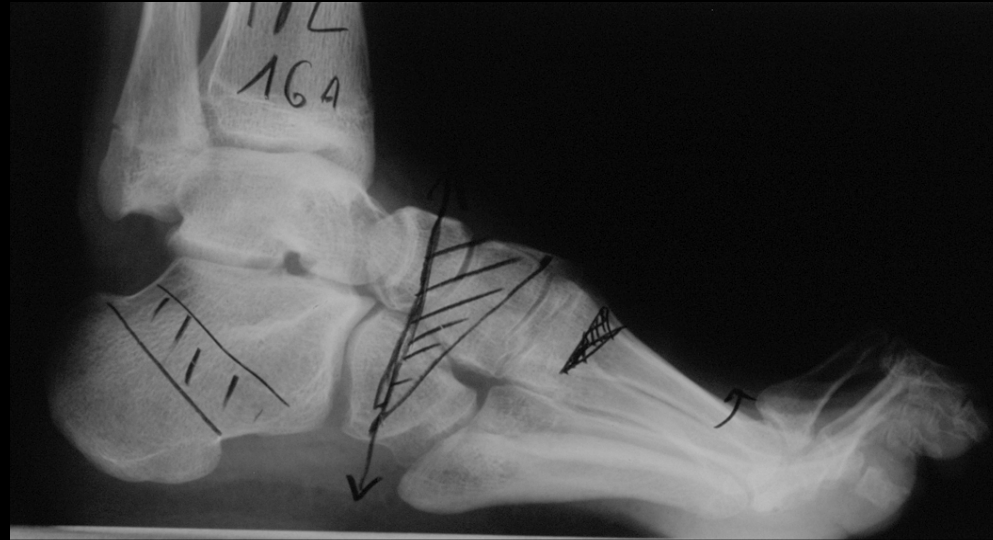
72 years old
Charcot ankle arthropathy

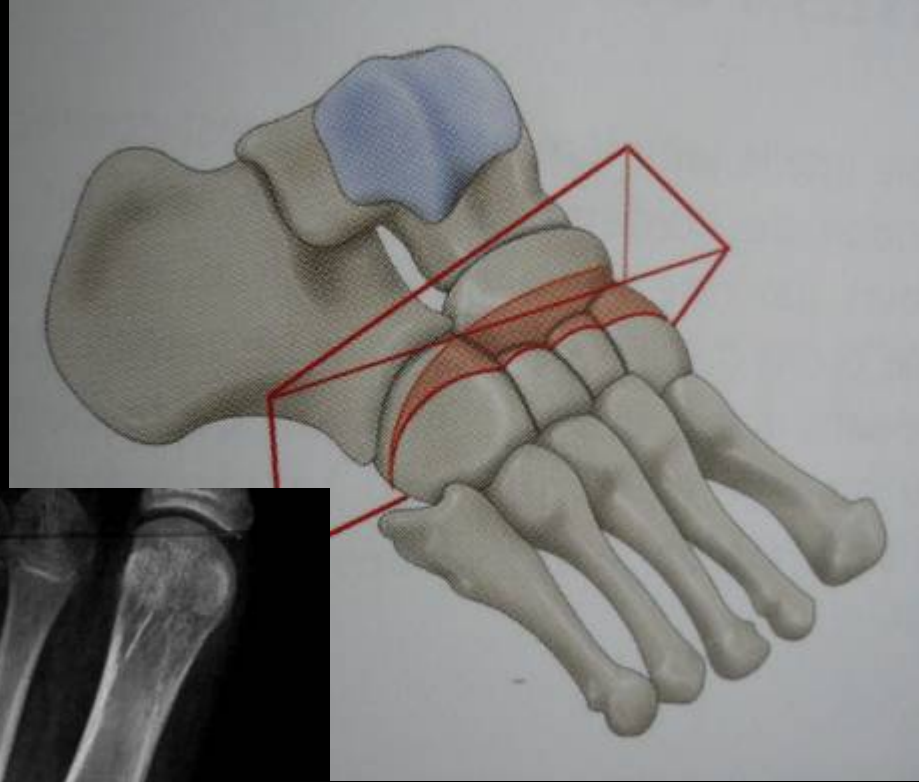


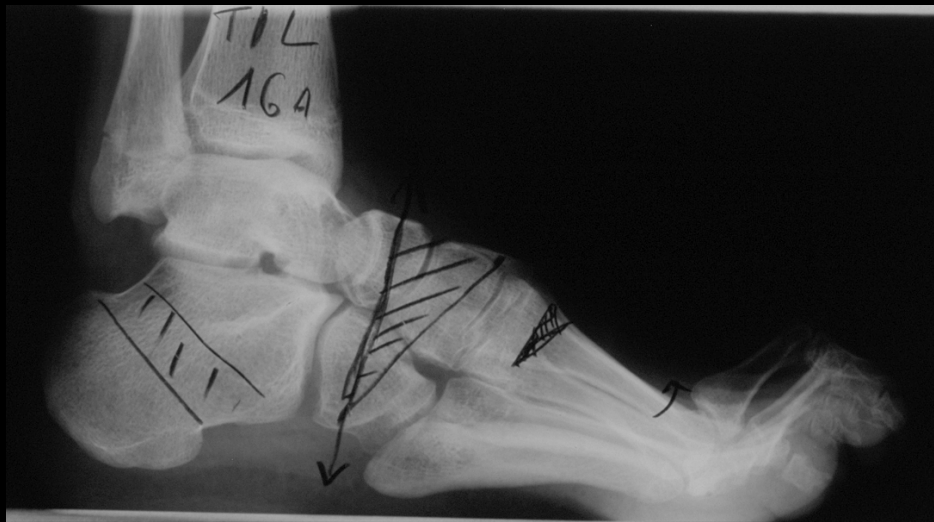


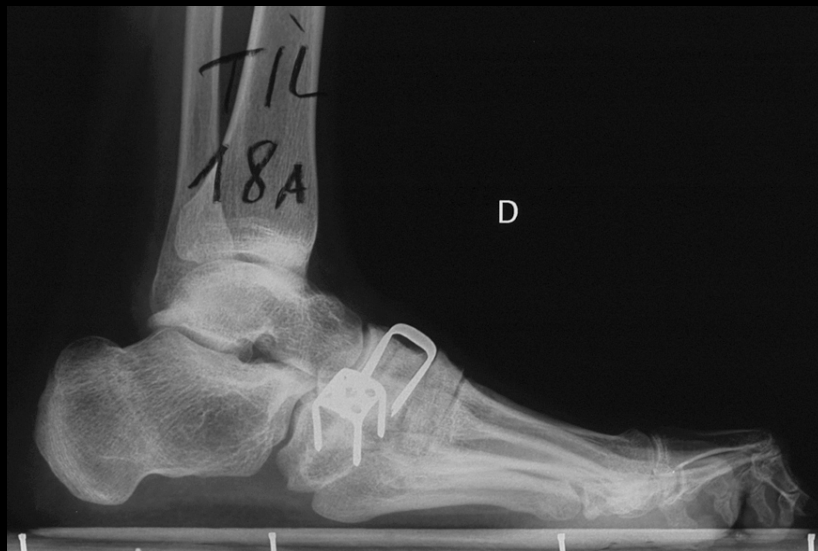
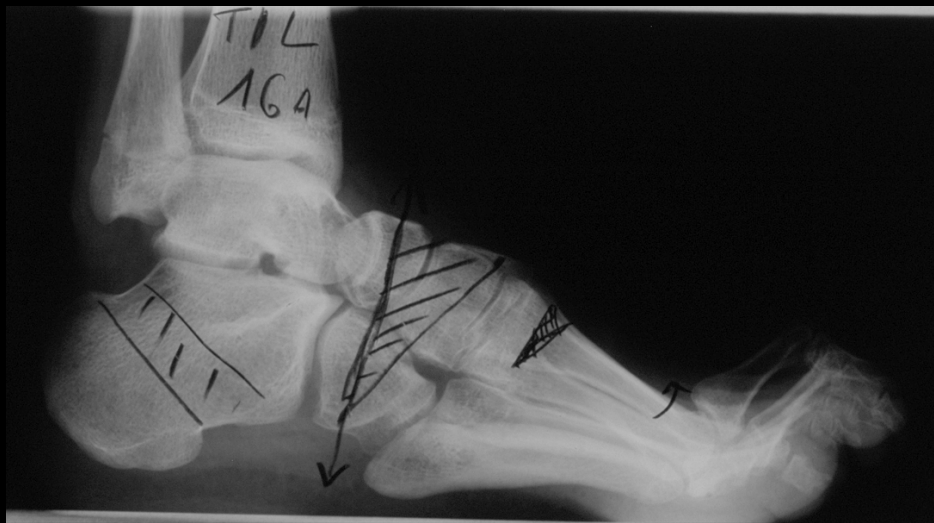
TIL 16 yo CMT

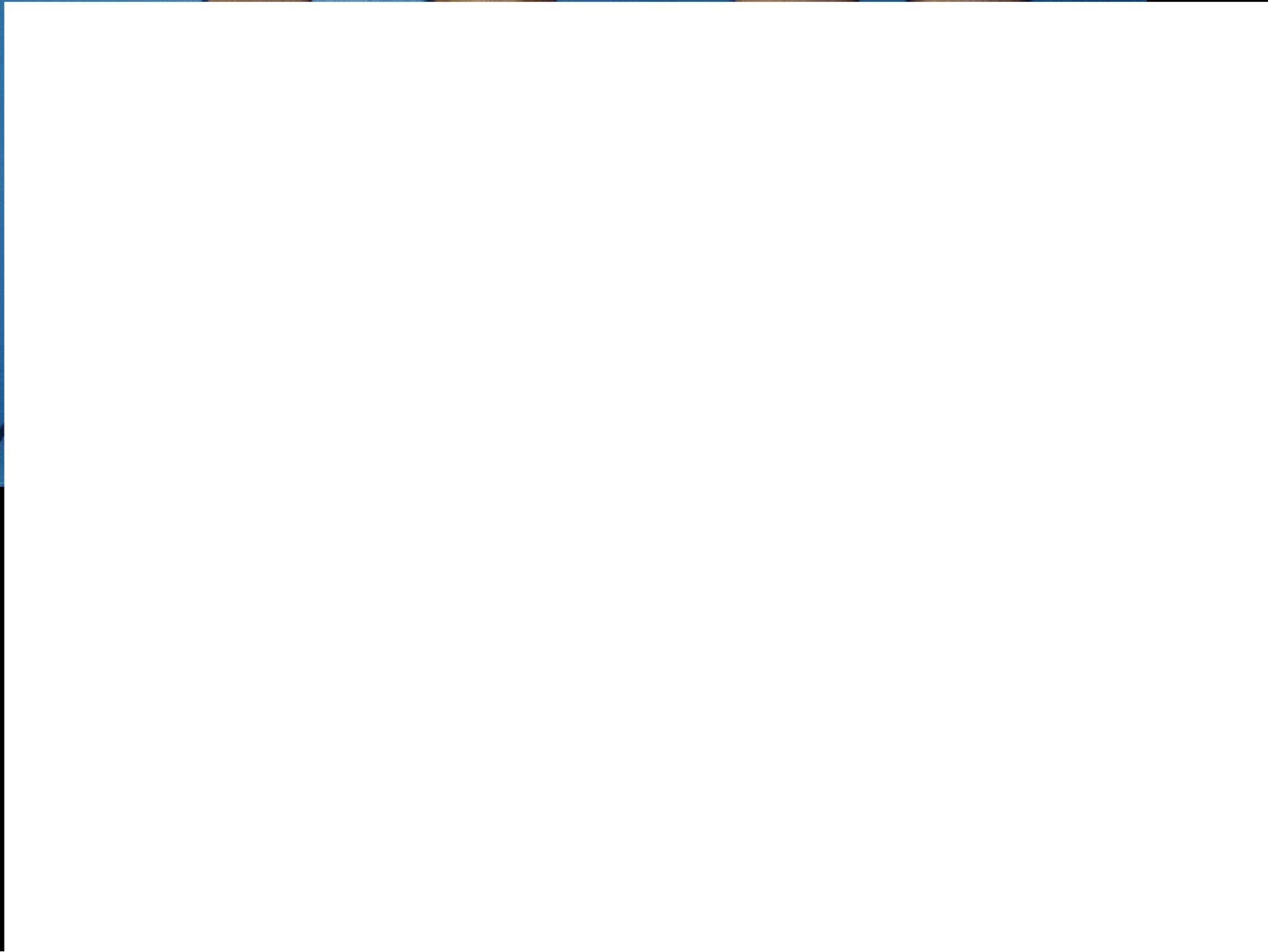
Dorsal tarsectomy











Modern treatment
(during childhood)

According physiopathology

1) Selective plantar release

+

Plantar opening wedge of cuneiform bones

Primary disorders : fore-foot pronation and cavus



According physiopathology

1) Selective plantar release

+

Plantar opening wedge of cuneiform bones

Primary disorders : fore-foot pronation and cavus



2) Calcaneal valgisation osteotomy

Dwyer. JBJS Br 1963 ; 45 : 67

Hind-foot varus (secondary)

Patients

Inclusion criteria

- . Enfant opéré pour pied cavovarus
- . 1980 à 2000
- . Recul : au moins 5 ans ou fin de croissance

26 children / 36 feet

Neurological pathology

Progressive : 75% (Charcot-Marie Tooth)

Static : 25% (IMC, dysraphisme)

Average age at surgery : 10,3 yo (5.5 to 13.6)

Dwyer osteotomy



Selective
plantar
aponevrotomy

Plantar open wedge osteotomy Cuneiform bones





Tendon achilles lengthening ?

Muscular transfer ?

V. Mosca



Tibialis posterior > fibularis brevis

Long fibularis > Tibialis Anterior

Tibialis anterior > 3ème fibular

**Triceps surae > Tibialis anterior and 3ème fibulaire
(then activation of long extensors)**

hind-foot

- Tibialis posterior lengthening
- Transfer of fibularis longus on fibularis brevis

Mid-foot

**Hemitransfer of Tibialis anterior on the cuboid or
3ème fibularis**

Fore-foot

- Jones transfer (Extenseur propre du I sur le col de M1)
- Hibbs transfer (Extenseur commun sur cuboïde ou 3ème fibulaire)
- Tenotomy of flexor tendons

Complex cooking !!!

Transfer of weak muscles

No data on the litterature

Combined procedures ++++++

Medial soft tissue release : 47%

Shortening of lateral column : 19%

Lichtblau. JBJS Am 1973 ; 55 : 1377

Osteotomy of 1st metatarsal : 61%



Method of evaluation of the results

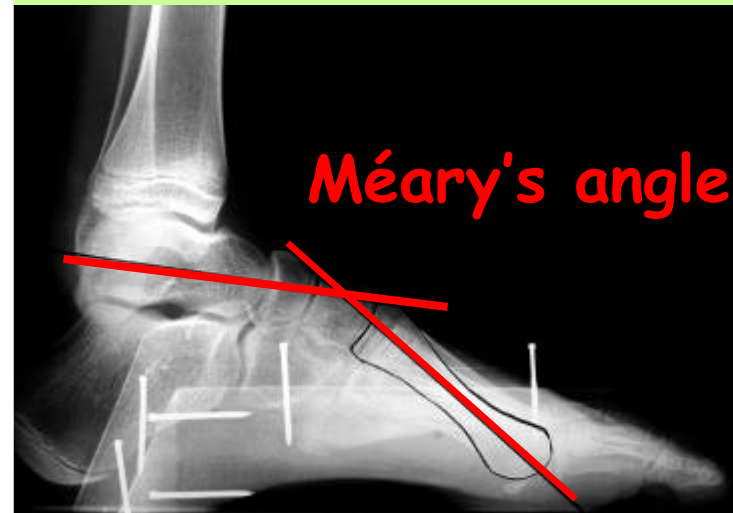
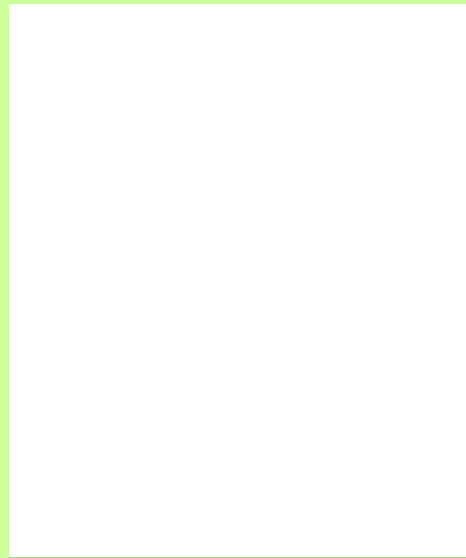
Wicart, Seringe. JPO 2006

1) Function : Pain, ankle sprain

2) Clinical hindfoot varus

3) Radiological cavus

Coleman modifié



4) Indication of triple arthrodesis : bad result

Global Result

Average follow-up : 7 years

Average age at follow-up : 17 yo

Very good : 8 (22%)

Good : 15 (42%)

Fair : 1 (3%)

Poor : 12 (33%)

64%

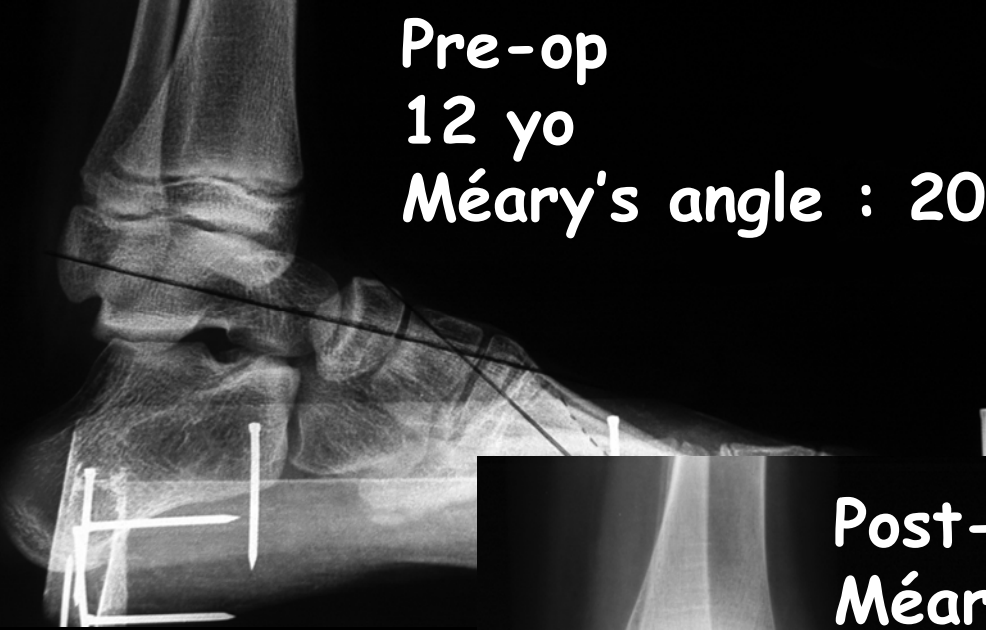




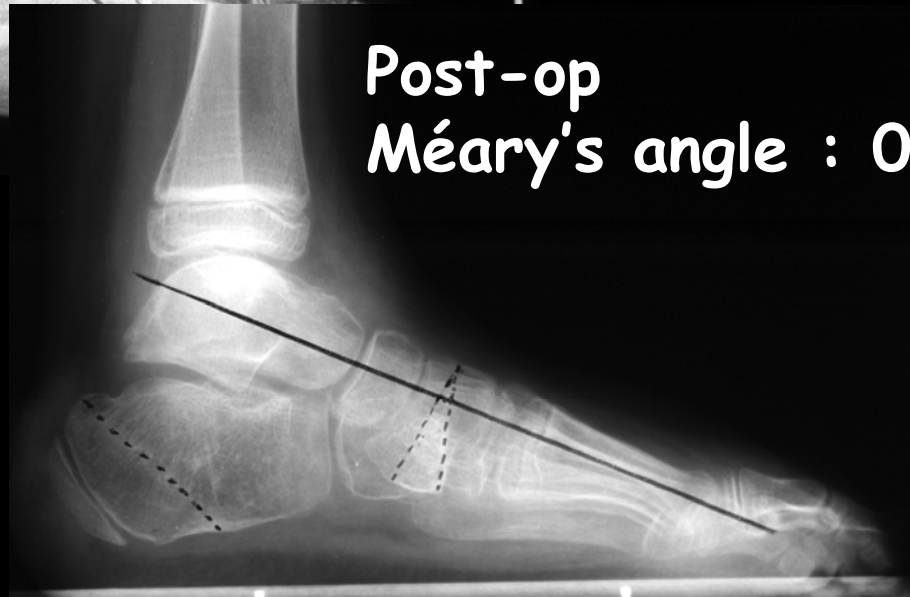
Pre-op
12 yo
Méary's angle : 20°

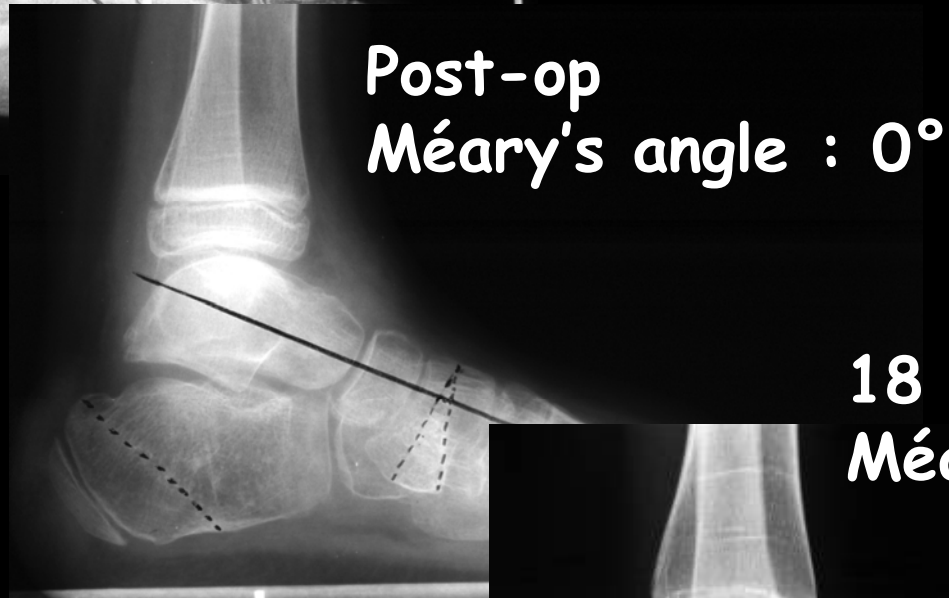


Pre-op
12 yo
Méary's angle : 20°



Post-op
Méary's angle : 0°





Very good and good results

No ankle sprain or pain

No limitation of activity

Flexible subtalar joint : 21 cases (87,5%)

Surgical correction of residual flaw

4 feet (11%)

Adduction

Plantar sticking of 1^{er} metatarsal

Discussion

Advantages of the methods

Corrects fore-foot pronation (primum movens)

Osteotomy at the apex of the déformation

Extra-articular surgery

2 inter-cuneal joints

Efficient at mid-term

Orthopedic treatment of pes cavovarus

Detwisting of calcaneo-pedal block

- Cast
- Nocturnal splint

Indications of Orthopedic treatment

Prevent or differ surgical treatment

Prevent post-op relapse

Correction :

- Fore-foot pronation
- Adduction
- Cavus and equinus



Correction :

- Heel varus

De-twisting nocturnal splint

- Correction of cavus
- Fore-foot supination
- Hind-foot pronation



Caroline, 9 yo, Charcot-Marie-Tooth





Modern treatment

Avoid triple arthrodesis

Orthopedic treatment +++++

Plantar osteotomy of cuneiform bones
(7 to 12 yo)

GENERAL CONCLUSIONS

- Differentiate direct cavus of cavo-varus feet
- Clinical and radiological +++ examinations
- Neurological examen
- nocturnal orthosis
- Surgery adapted to deformations

