

Principles of triple arthrodesis

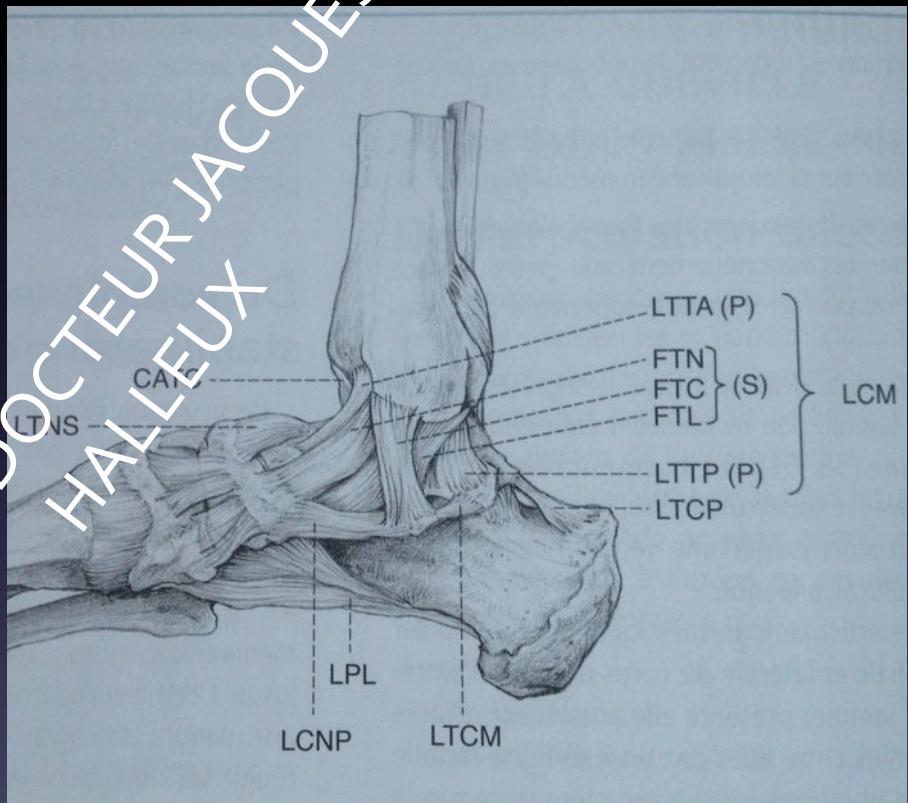
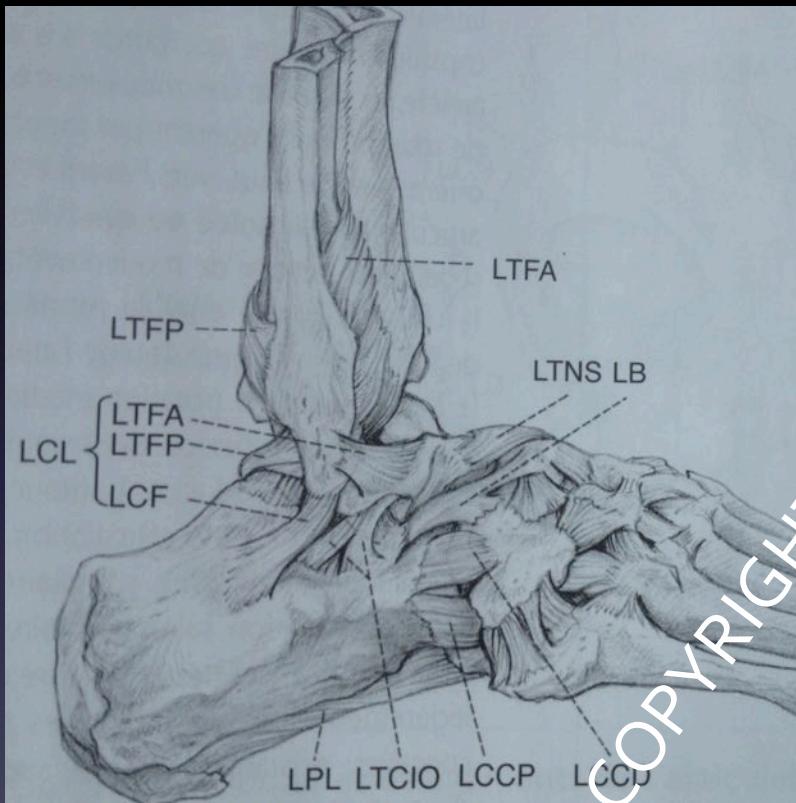
Integrated™ Ankle Days

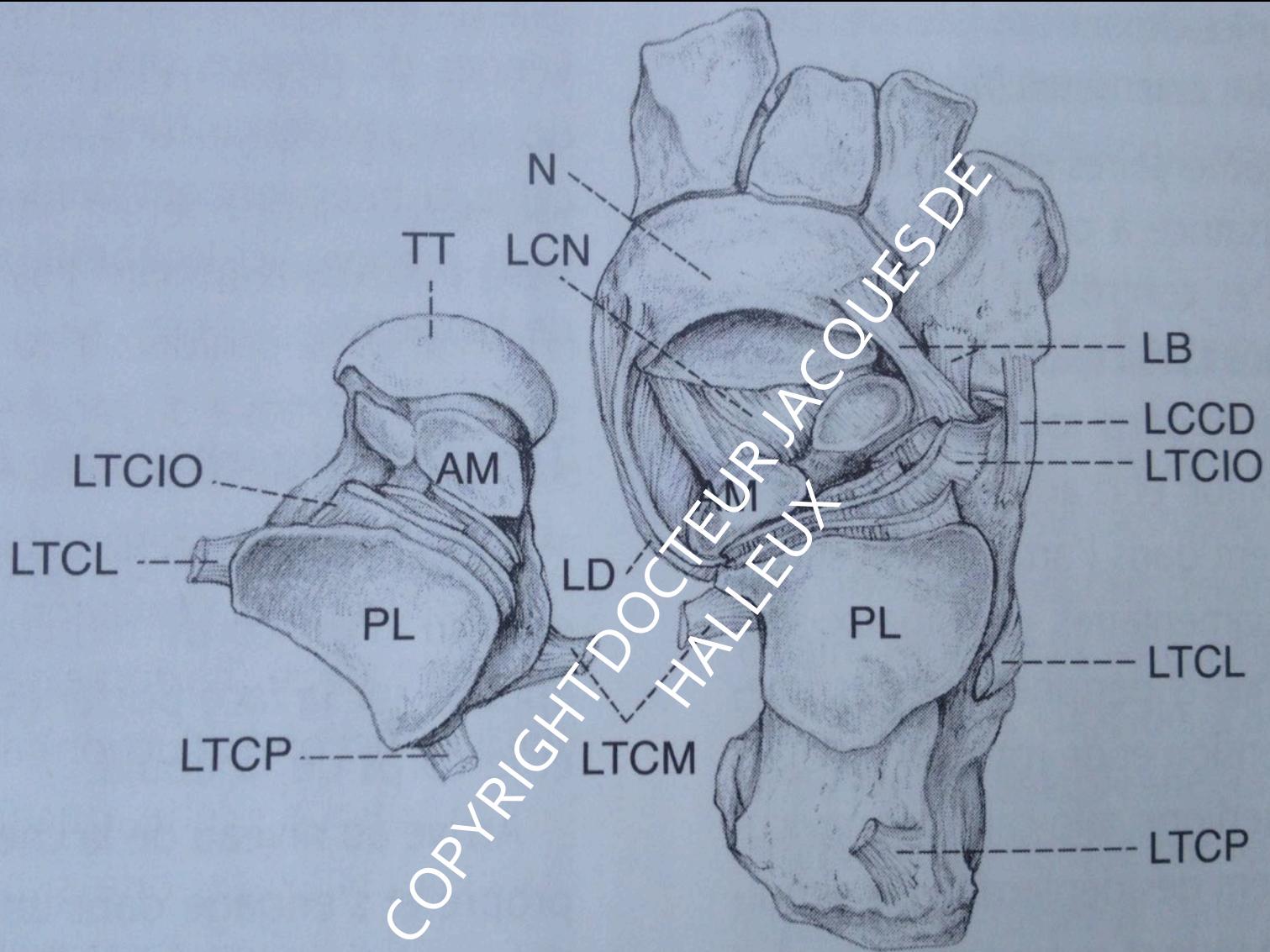
Ankle and Hindfoot Training

May 09th & 10th 2014 – Brussels, Belgium

J. de Halleux

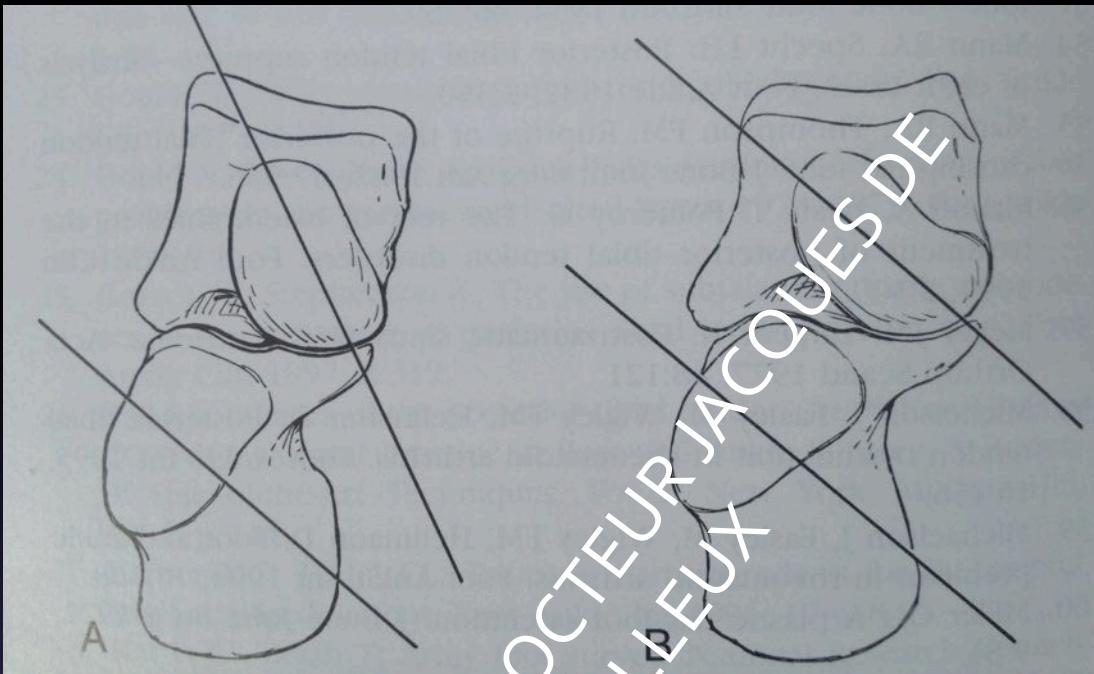
ANATOMY





BIOMECHANICAL CONSIDERATIONS

during the stance phase gait



1. Heel strike: inversion of the heel

- axes talus and calcaneus less parallel to each other
- more rigidity to receive initial load

2. Body weight forward: eversion of the heel

- axes talus and calcaneus more parallel to each other
- more flexibility

3. Push-off: inversion (idem)

BIOMECHANICAL CONSIDERATIONS

TN joint = pivotal joint

- Large amount of rotation occurs through the TN joint during gait
 - incidence of TN nonunion is higher
 - better function of the foot if TN joint can be spared
- Hindfoot deformity is often fully corrected by including the TN joint * (*only subtalar arthrodesis do not correct severe hindfoot deformity and in some cases can make it worse*)

* O'Malley and all, selective hindfoot arthrodesis for the treatment of adult acquired flatfoot deformity: an in vitro study. *Foot Ankle Int* 1995; 16:411-417

Effect of isolated hindfoot arthrodesis

Type of arthrodesis	Diminution ROM subtalar	Diminution ROM TN	Diminution ROM CC	Diminution ROM TT
subtalar	100%	26%	56%	13° loss
Talo-navicular	>60%	100%	+++	10-15° loss
Calcaneo-cuboidal	15-35%		100%	?

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Triple Arthrodesis

- Fusion of ST + TN + CC
- English Triple arthrodesis =
French « double arthrodesis »
- Improvement Hindfoot
function (*no pain and correction
of the axial deformations,
plantigrade position*)



OPTIMAL POSITION FOR FUSION

- Subtalar joint = 5 to 10° valgus
- Rotate transverse tarsal joint into a plantigrade position
 - *!NO forefoot varus/supination position!*

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Indications of triple arthrodesis

- Primary Arthritis : *pes planus or pes cavo-varus*
- Posttraumatic Arthritis : *calcaneal or talar fracture*
- Hindfoot Arthritis : *synostosis or residual clubfoot deformities*
- Rheumatoïd Hindfoot Arthritis: *PRESAA, goutte...*
- PPV and Tibialis posterior dysfunction (Stadium III or more)
- Severe Pes cavus deformities
- Paralytic foot: *Polio, cerebral palsy , Charcot Marie Tooth (Large bone resections)*

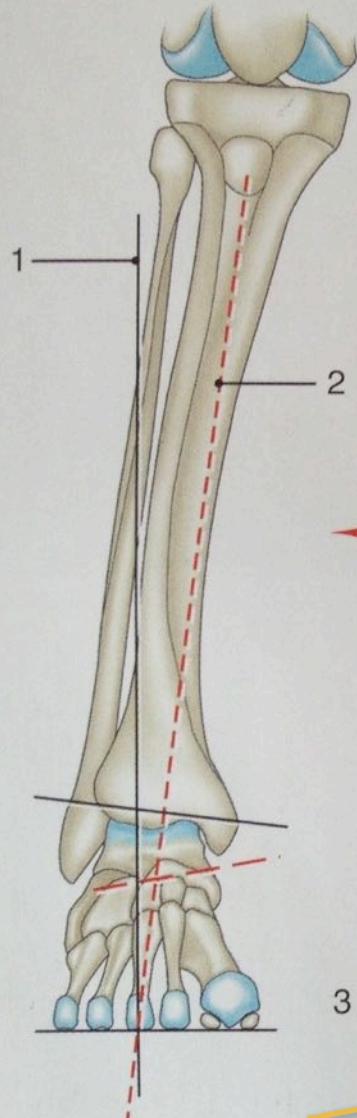
Not to be used if soft tissue procedure or osteotomy or isolated arthrodesis are possible

PREOPERATIVE EVALUATION

- **SOFT TISSUE :**
 - previous scars, skin or muscular grafting
- **CIRCULATION :**
 - dorsalis pedis and tib post pulses, ankle-brachial index of 0,75 to 0,5
- **SENSATION :**
 - 5,07 monofilament of Semmes-Weinstein (!diabetic peripheral neuropathy!)
- **ALIGNMENT :**
 - Genu valgum / Genu varum
 - weightbearing = 5 to 7° calcaneal valgus
 - forefoot abd or adduction
 - rotational position of the forefoot

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QUESTIONS DE

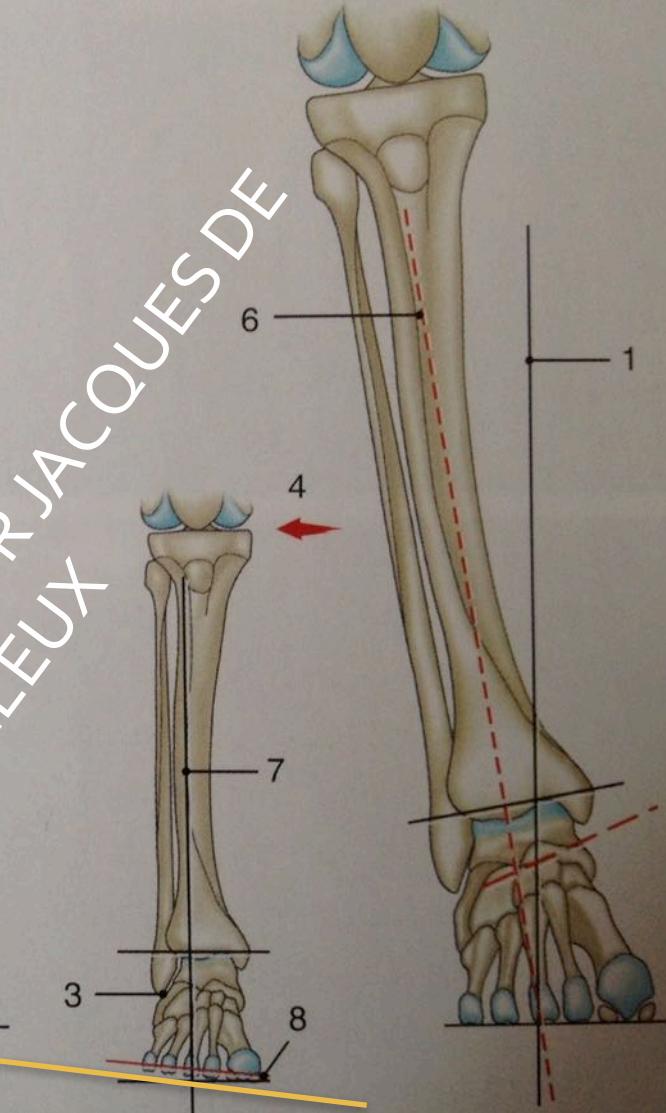
Genu Valgum



Neutre



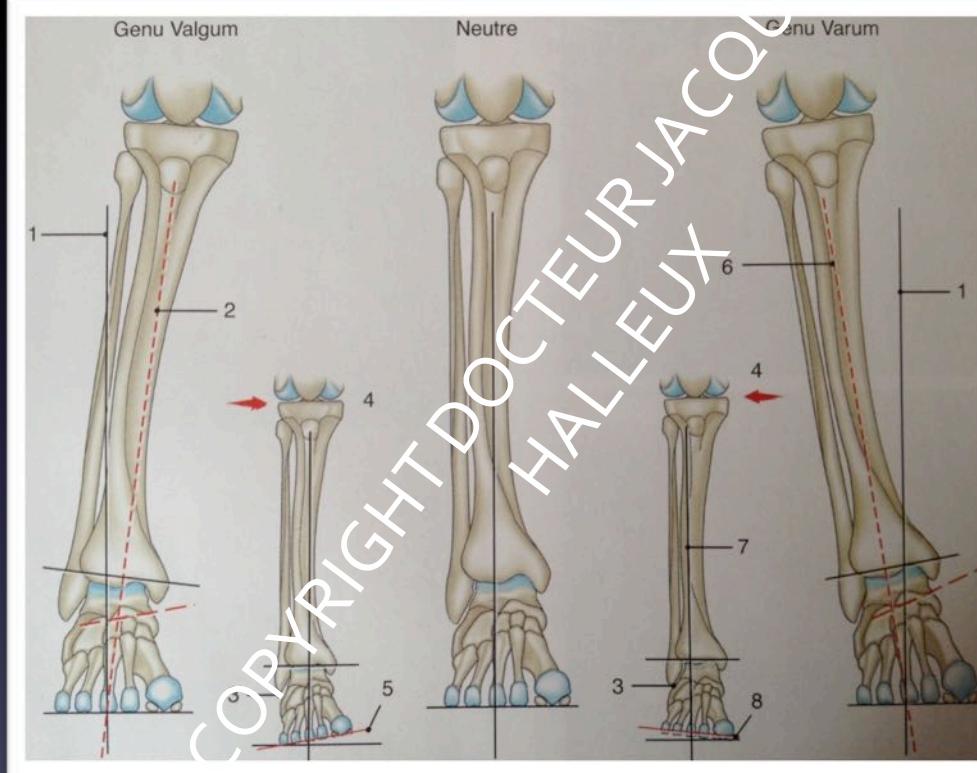
Genu Varum



Forefoot suppination

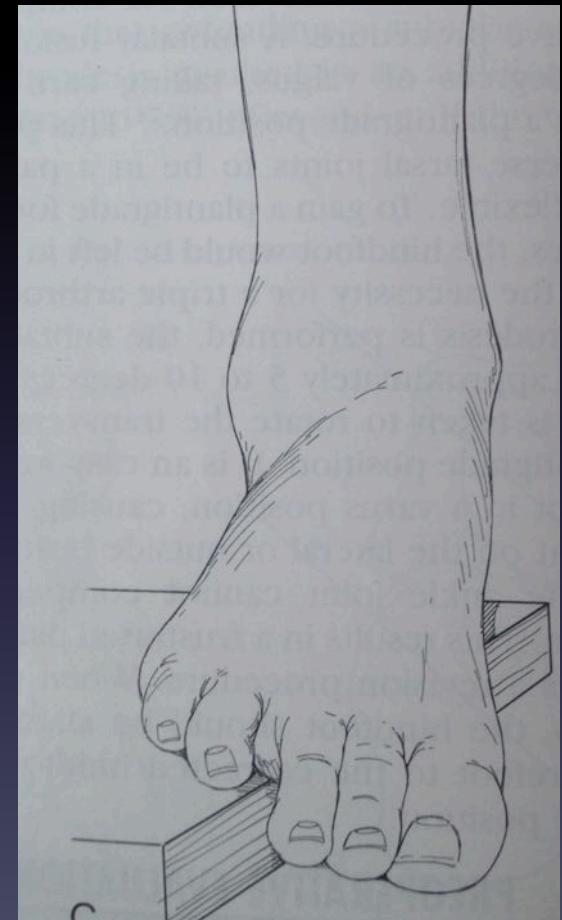
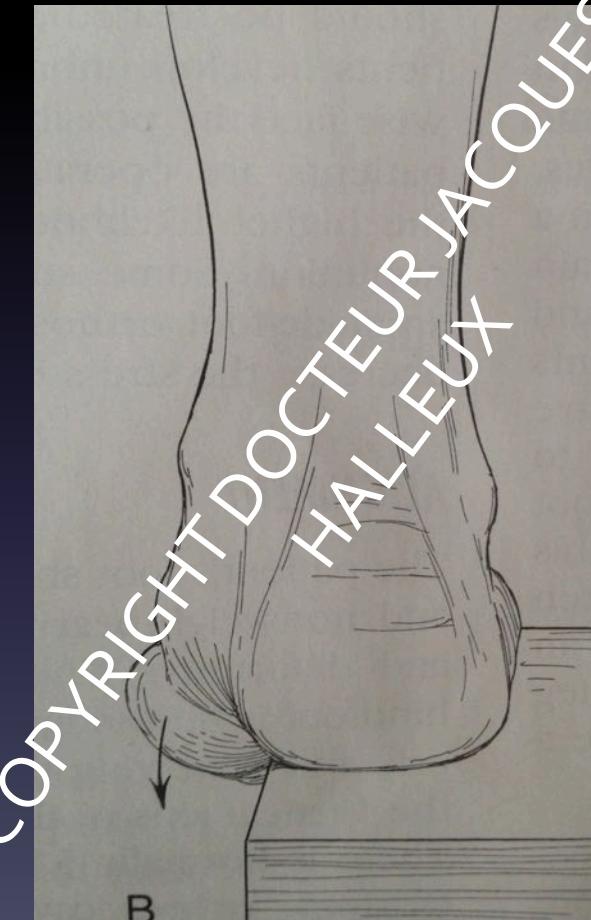
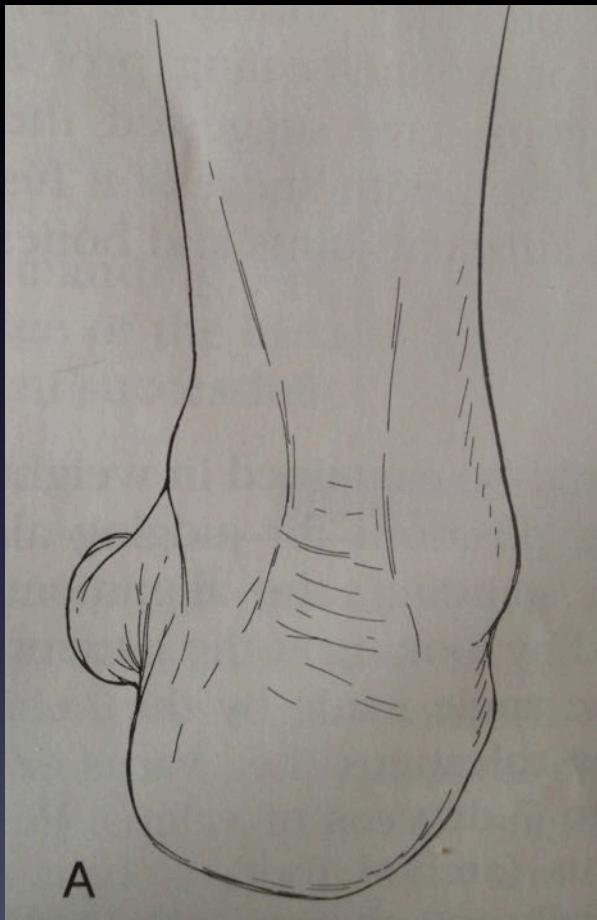
Forefoot pronation

First correct tibial axis deformation triple arthrodesis later!



FLEXIBILITY OF THE HINDFOOT: Coleman and Chesnut block

Flexible deformitie : osteotomy or tendon transfer procedure



Non fixed varus hindfoot deformity

Achilles Tendon tightness

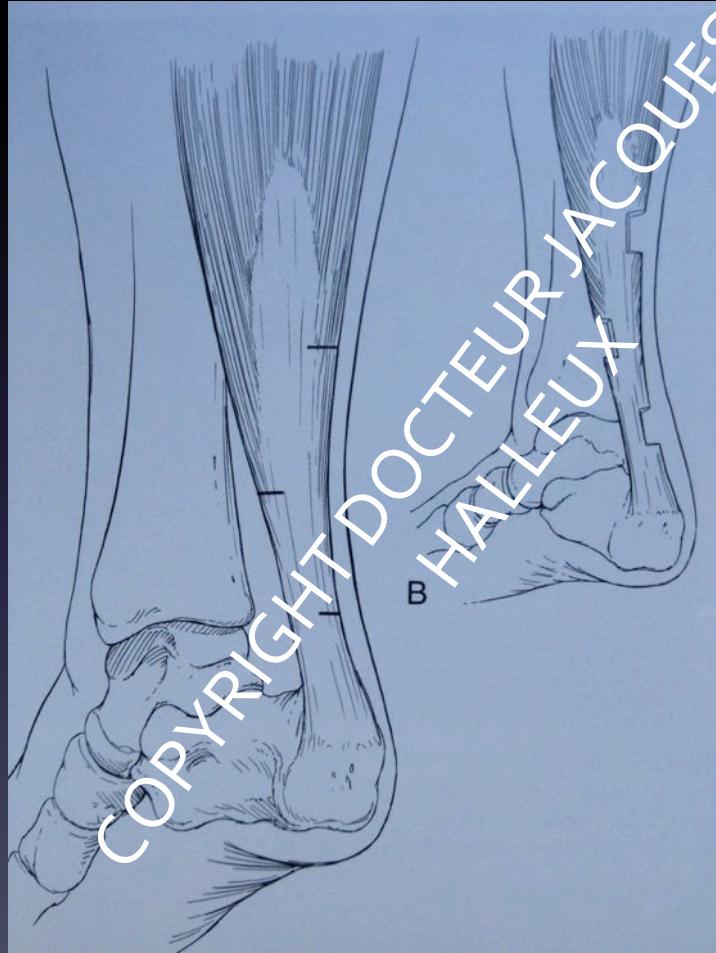
If Triple arthrodesis performed :

peroperative difficulty to correct hindfoot deformities

→ Achilles tendon lengthening procedure

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Achilles tendon lengthening procedure



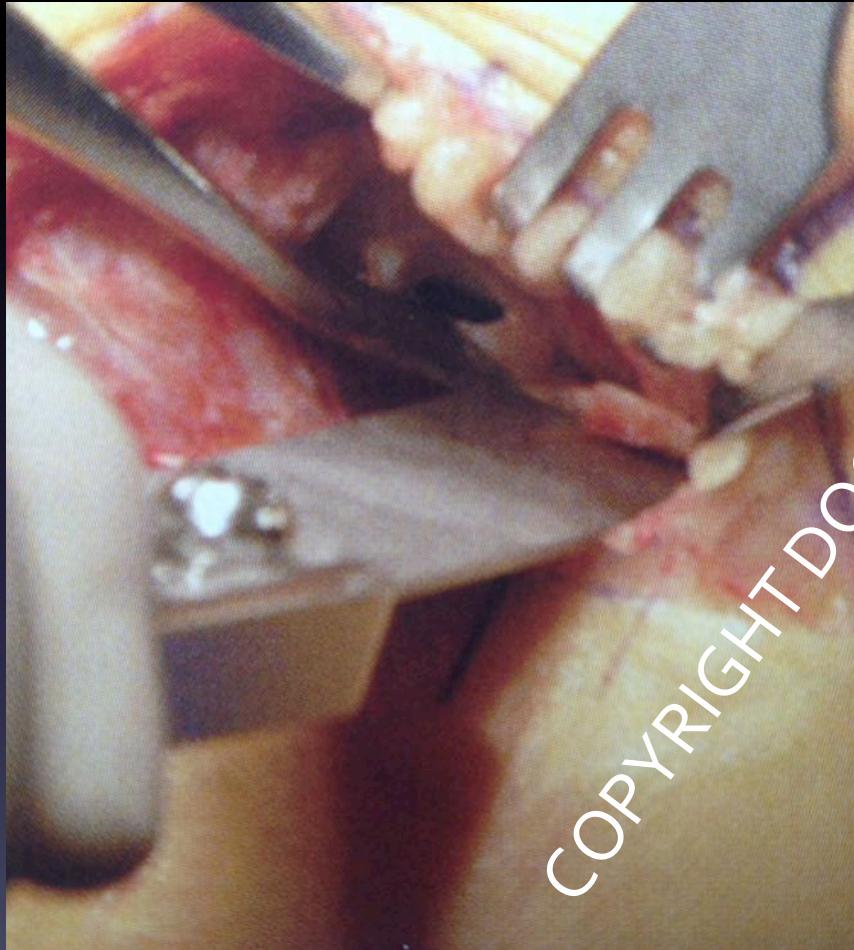
SURGICAL TECHNIQUE

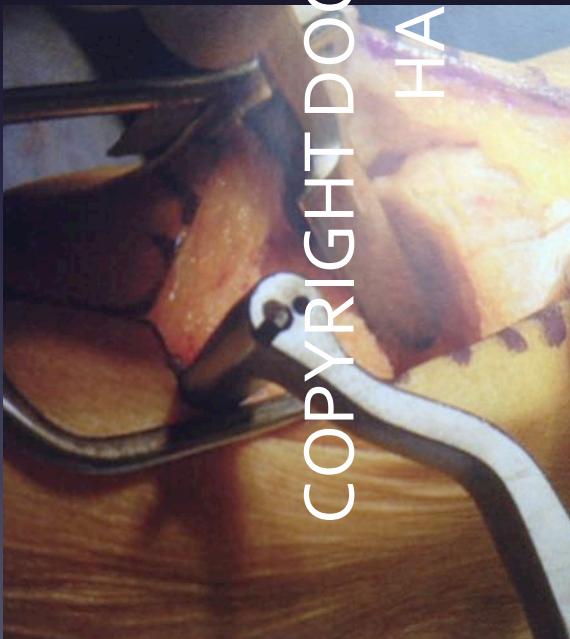
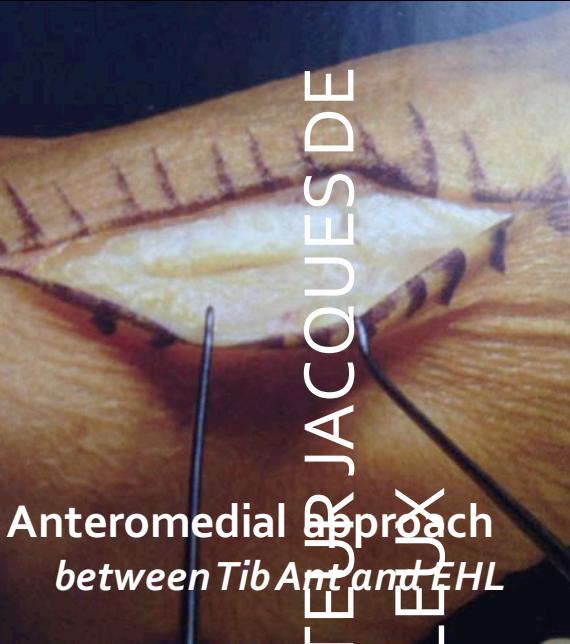
- Supine position
 - sandbag underneath the ipsilateral buttock
- Lateral incision
 - (tip fibula to base MT4)
 - Sural nerve inferiorly!
 - Fib Sup nerve superiorly
- Ollier incision over the sinus tarsi
 - better approach for TN
 - ! Superficial nerve



Remove articular cartilage from the subtalar joint (anterior and posterior facets)

! **FHL** in the postero-medial subtalar joint





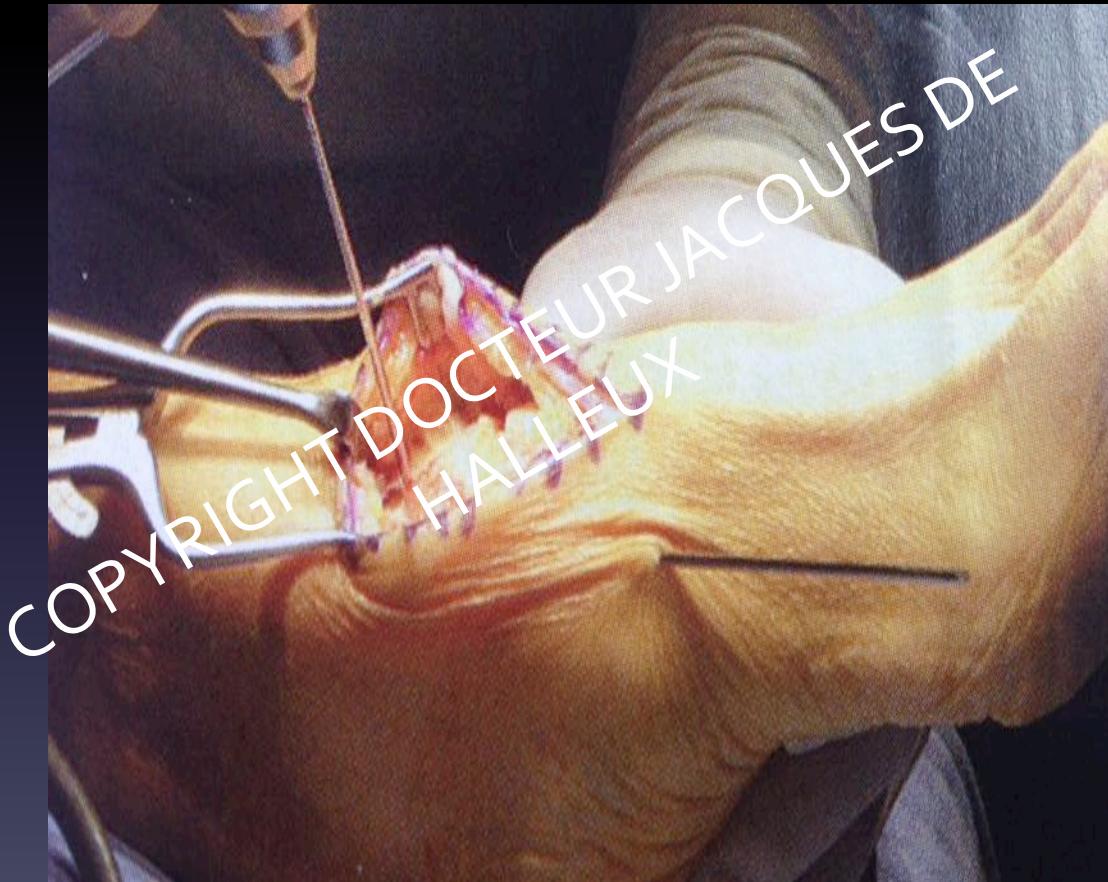
1° = REDUCTION AND STABILISATION TN JOINT

- TN = Key joint to allow excellent correction of the 3 joints
 - PPV = *Forefoot plantar flexion + adduction*



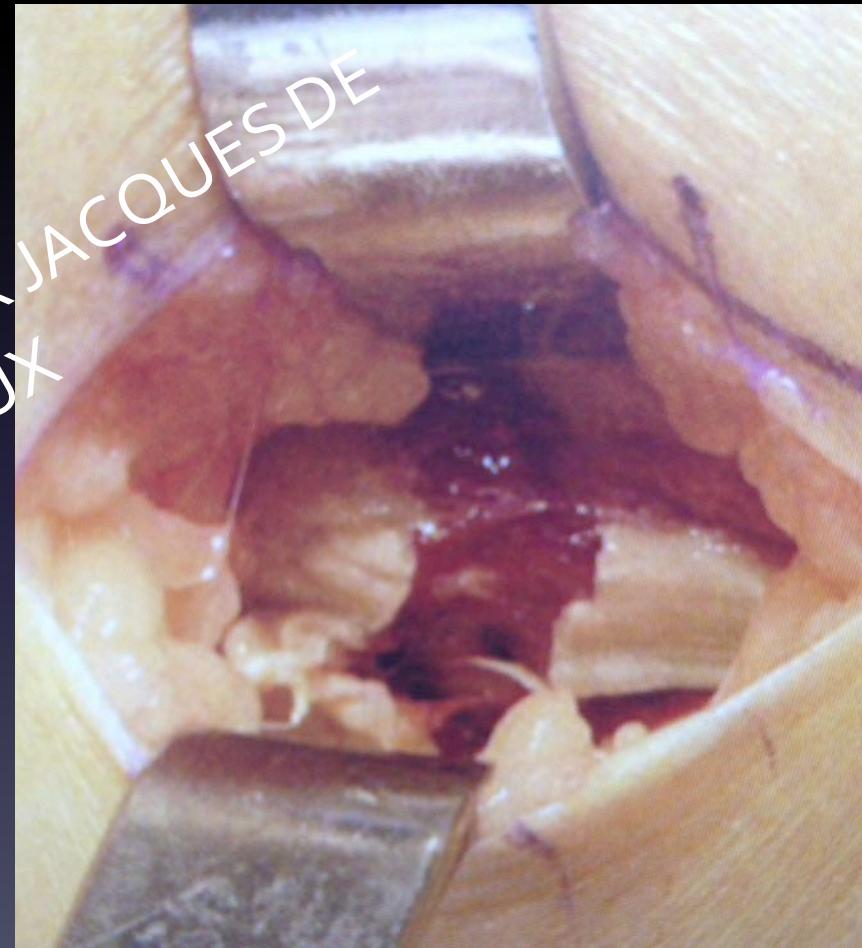
2° = REDUCTION AND STABILISATION TC JOINT

- *Subtalar joint = 5 to 10° valgus*



Achilles Tendon lengthening if necessary

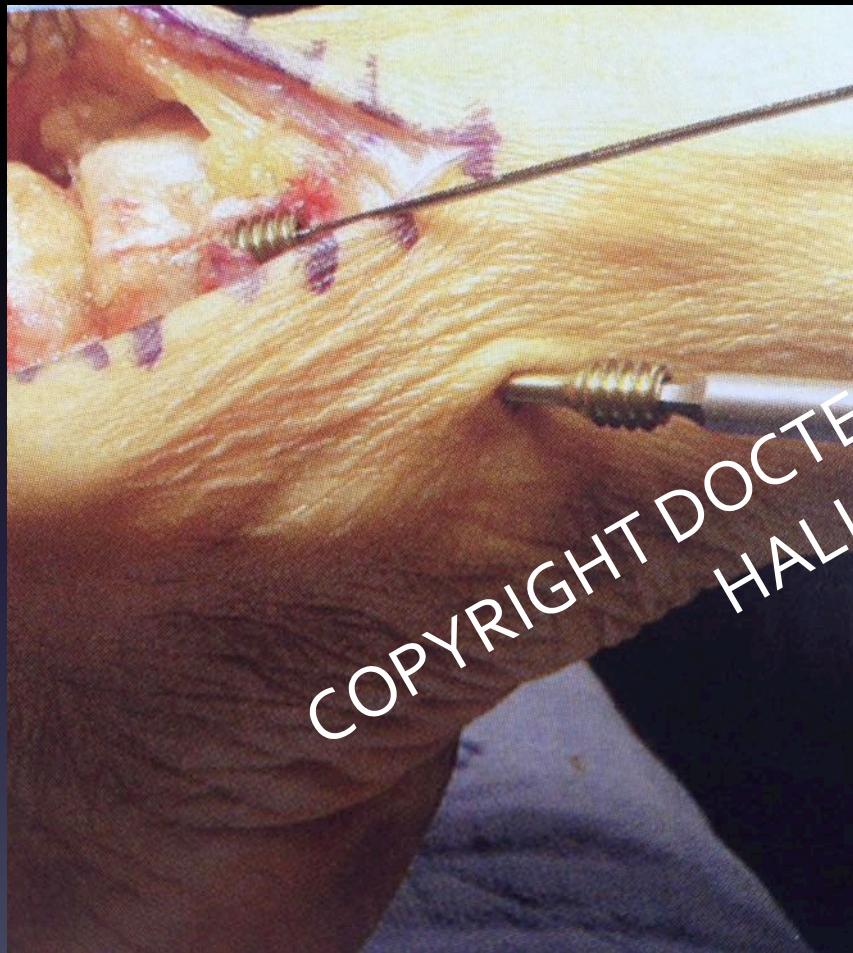
- Transverse incision fascia gastrocnemius
- foot is supinated and dorsiflexed to have elongation



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Talo Navicular Screws

2 canulated screw 4,5 mm



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Talo Calcaneal screw

1 or 2 cannulated screws 6,5 / 7,0 mm





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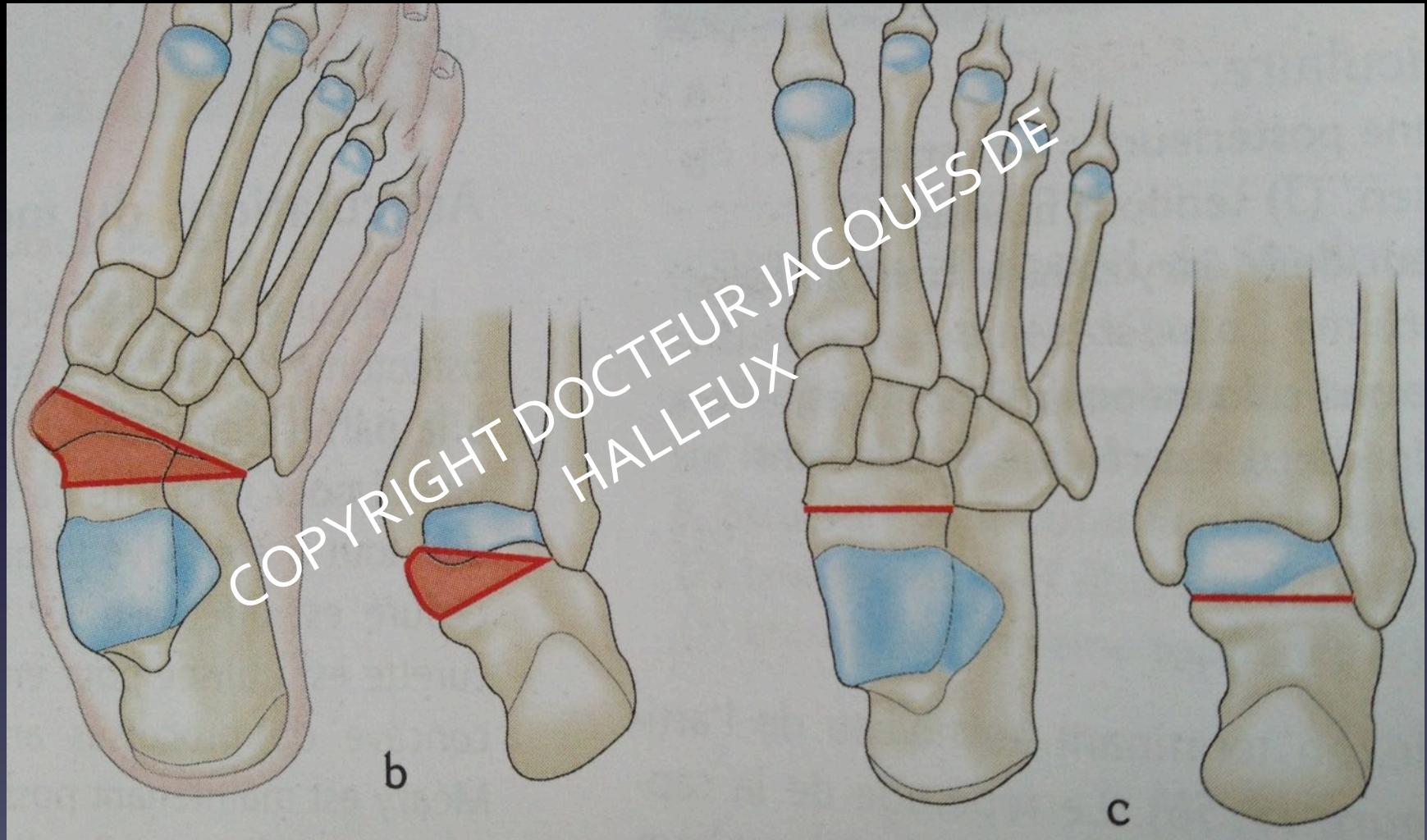
CALCANEO CUBOIDAL?

- Isolated ST fusion :  ROMCC 56%
- Isolated TN fusion :  ROMCC +/- 100%

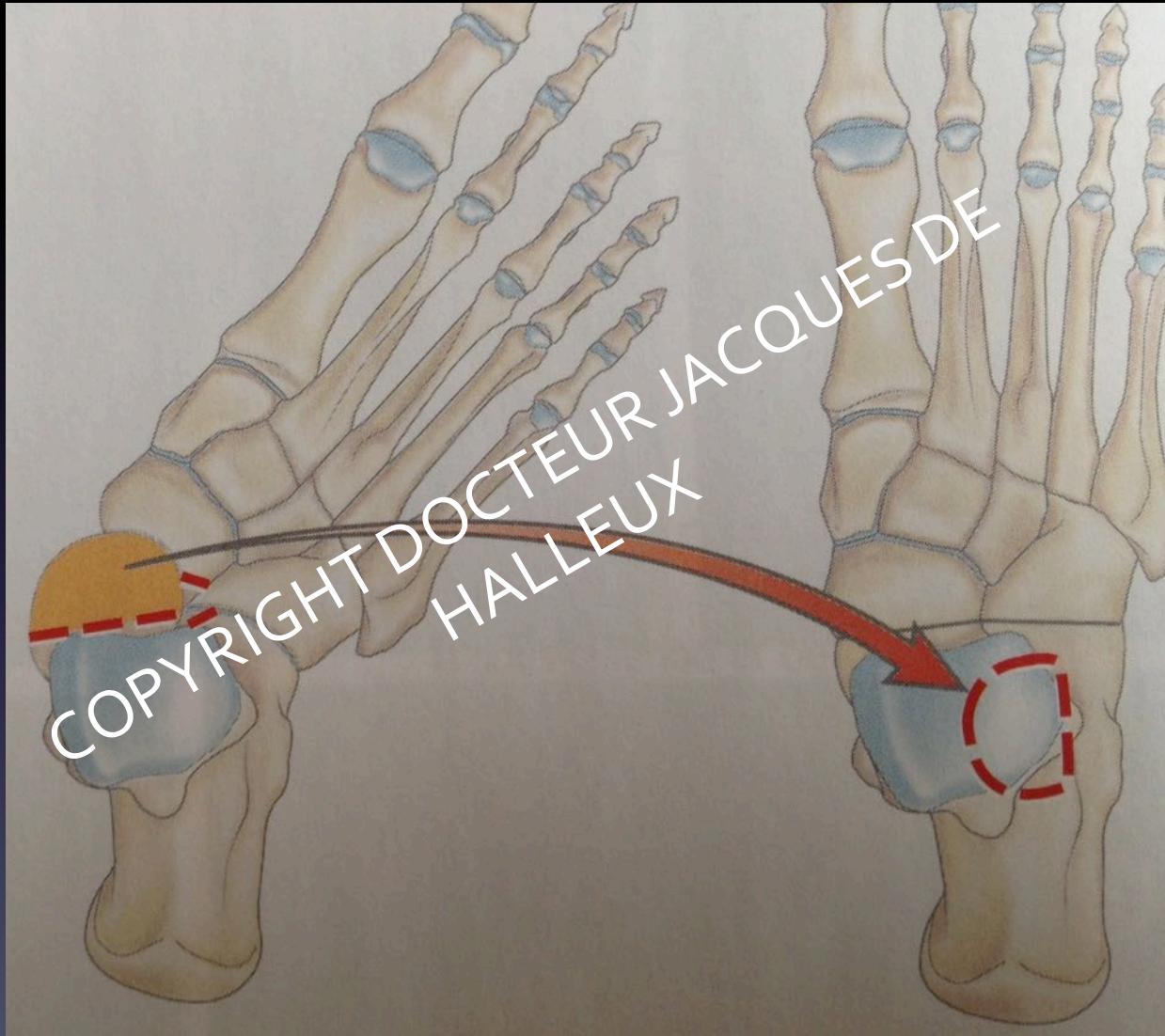
(Astion DJ and all, Motion of the hindfoot after simulated arthrodesis, JBJS Am, 1997)

- Only if
 - lateral column lengthening is needed (PPV)
 - lateral column shortening is needed (PCV)
 - painful CC arthritis
- Remove cartilage CC
! Not extensive if need lateral column lengthening (PPV)

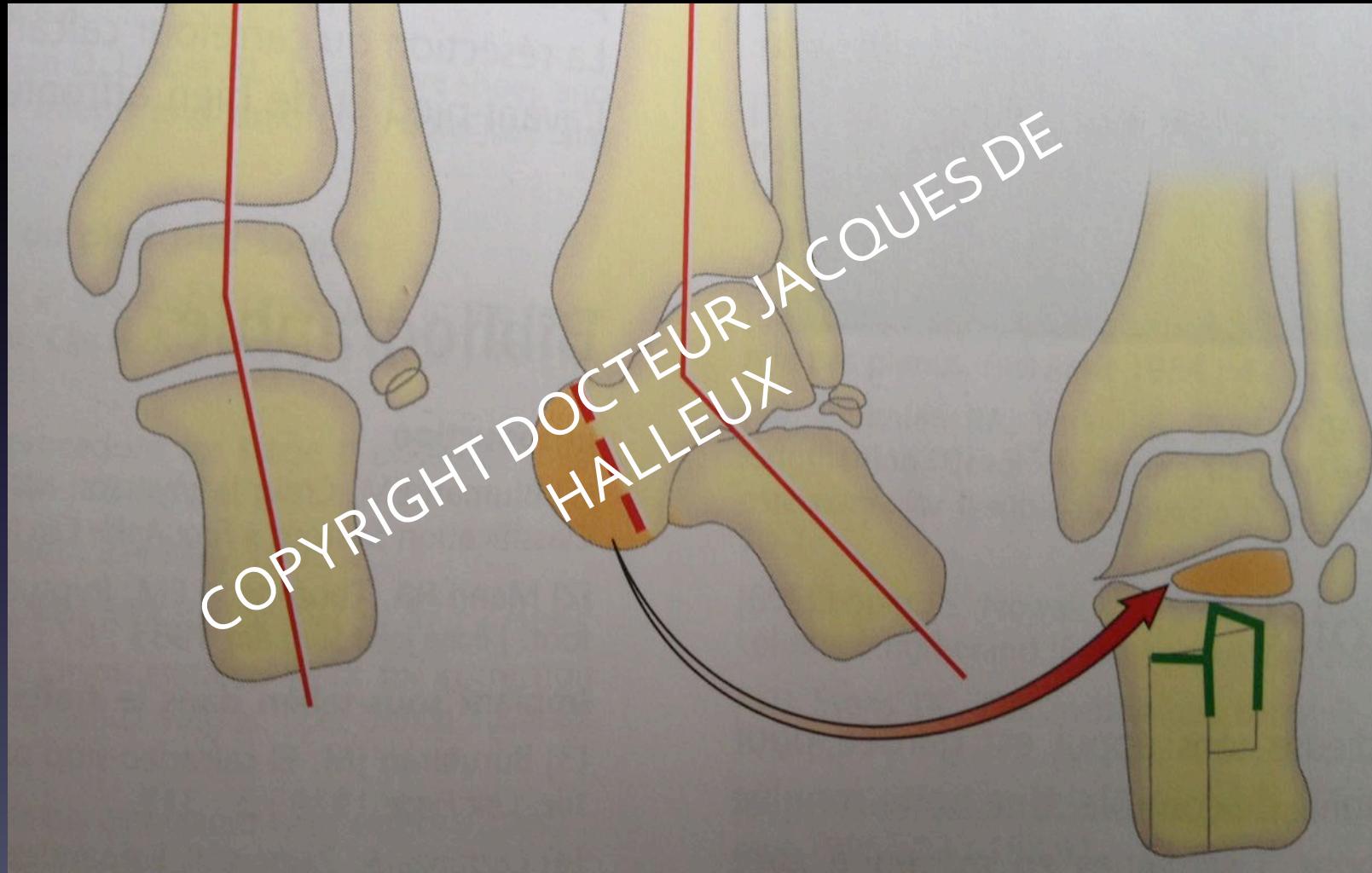
Pes Plano Valgus



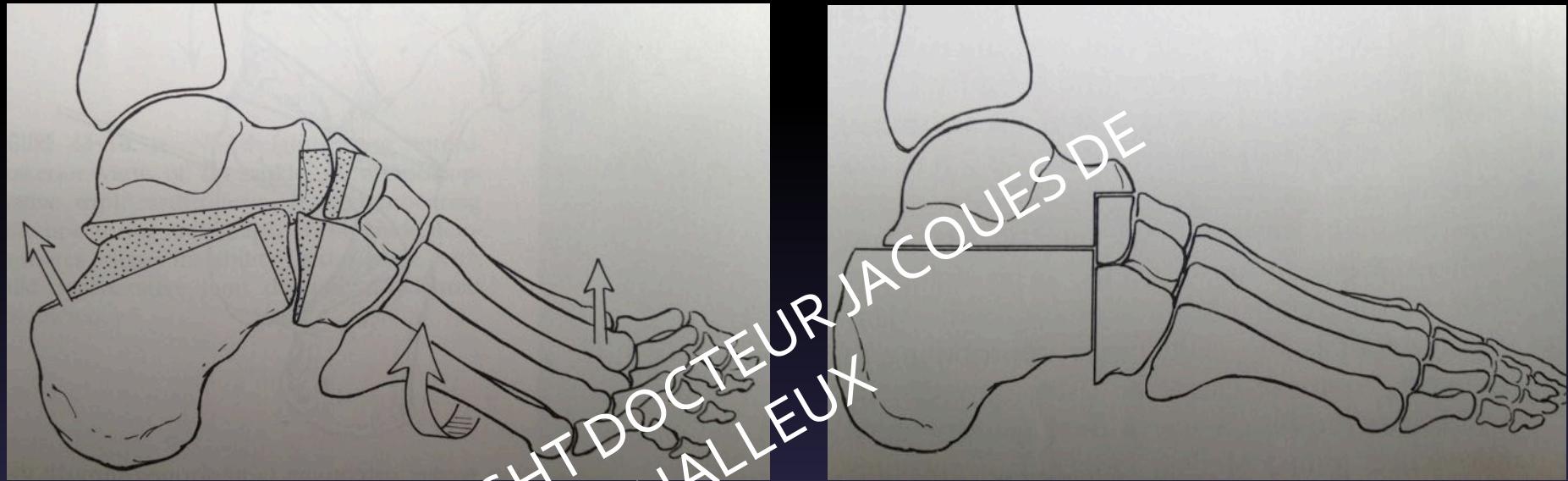
Pes Plano Valgus +++



Pes Plano Valgus +++



Pes Cavo Varus



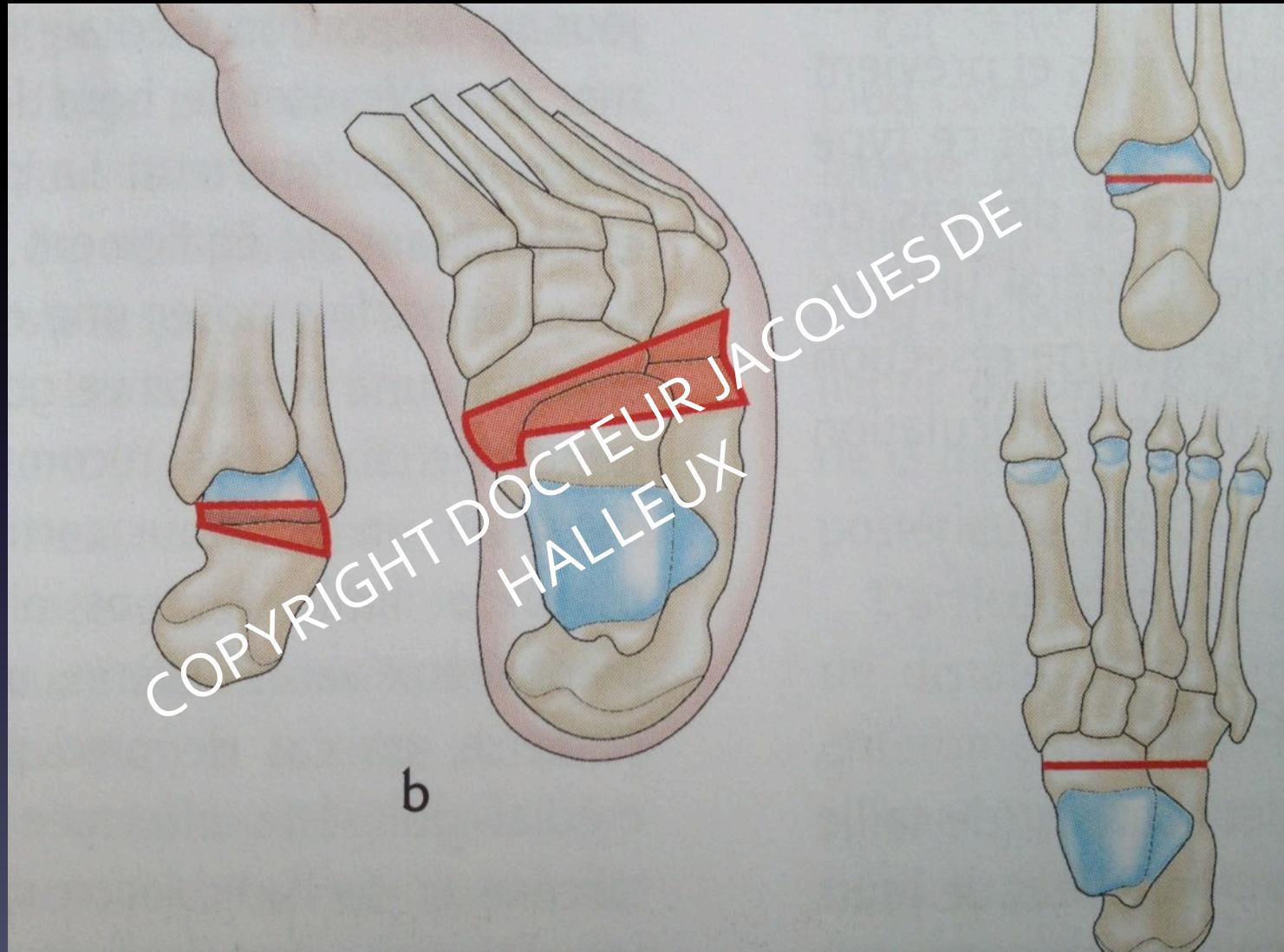
SIFFERT TRIPLE ARTHRODESIS :

- Dorso-Lateral closing wedge in subtalar + mortising Navicular into the Talus head
- Depressing the navicular, cuboid and cuneiforms while allowing elevation of the MT

PLANTAR FASCIA RELEASE (Steindler)

contracture F PI leads to forefoot plantar flexion + calcaneal varus

Pes Cavo Varus



CONCLUSION

- **First correct tibial deformation**
 - genu varum, genu valgum
- **Optimal position : Plantigrade foot!**
 - ST = valgum 5°
 - TN = forefoot NO suppination
- **TN joint = key joint :**
 - 1st TN reduction
 - 2th ST reduction
- **Achilles Tendon Tightness?**
 - Lengthening procedure
- **CC fusion necessary only if**
 - Arthritis
 - Lateral column lenghtening/shortening



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Achilles Tendon tightness

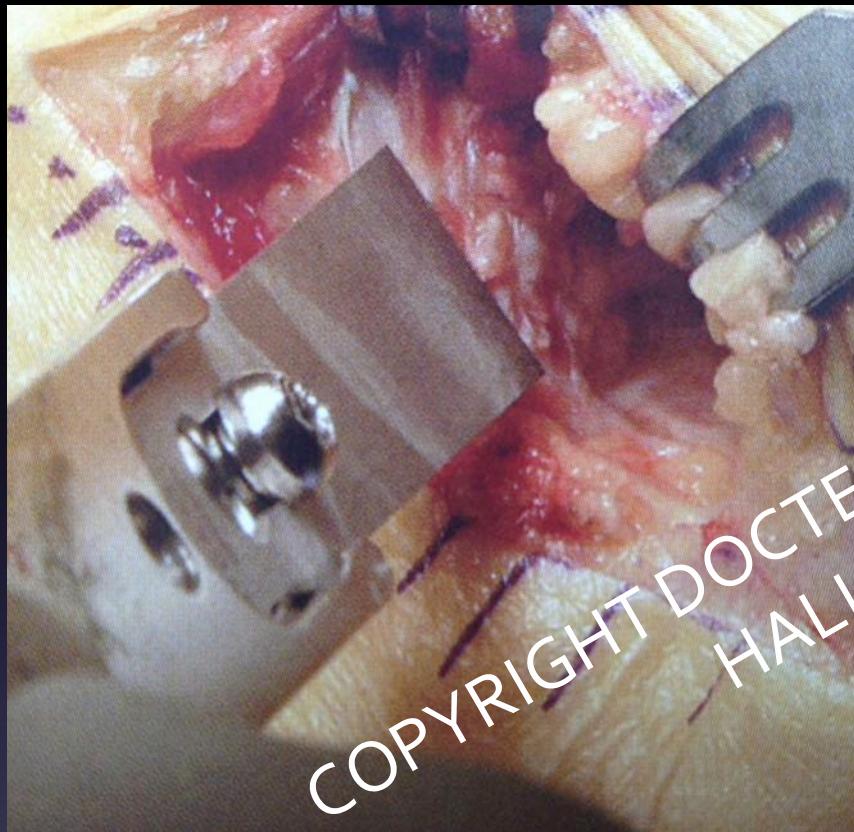
If Triple arthrodesis performed :

- peroperative difficulty to correct alignment of the hindfoot
- with correction of the deformity : Achilles tendon will restrict dorsiflexion **Transverse tarsal joint compensate**

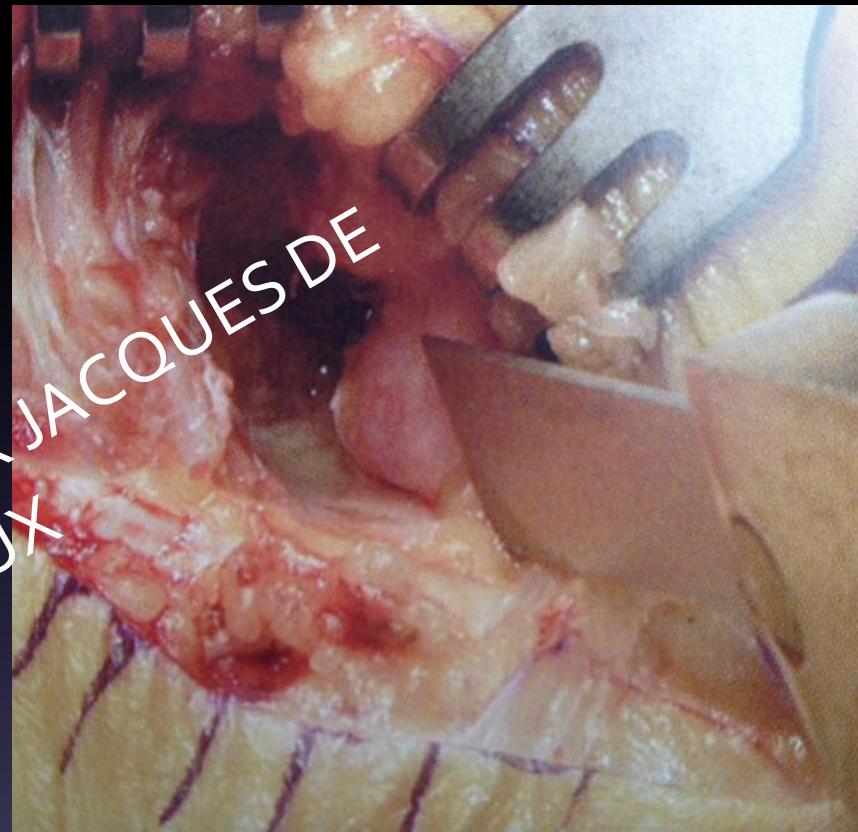
→ Achilles tendon lengthening procedure

Radiographic evaluation

- **X Ray**
 - Weightbearing X Ray Foot : anteroposterior, lateral and oblique
 - Weightbearing anteroposterior and mortise Xray of the Ankle
 - Ankle varus and valgus stress views if instability
 - Standing full-length radiographs (*mechanical axis of the tibia*)
- **(Arthro) Ct scanner**
- **MRI**
- **Scintigraphy**



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- Resection calcaneal anterior process : better vision anterior facet
- Resection inferior lateral portion of the posterior talar facet : better vision posterior facet

Distraction sinus tarsi : better vison
posterior facet

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Anteromedial approach
between Tib Ant and EHL



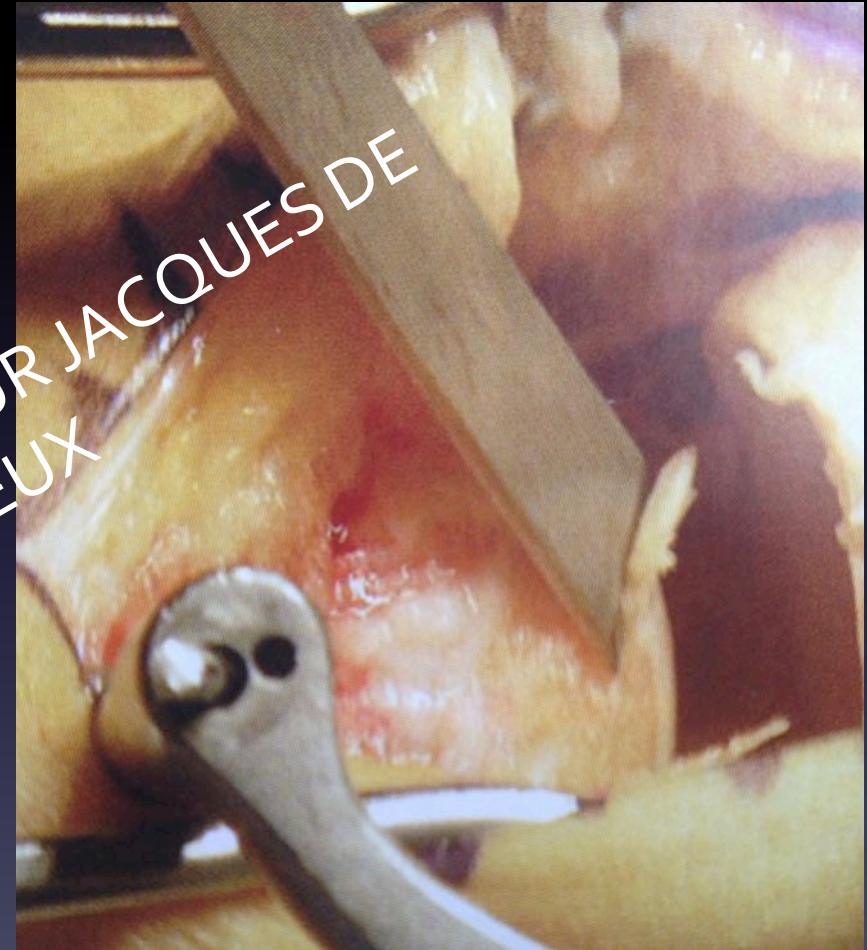
Talonavicular exposure



Ps: Medial incision: tip medial malleolus to the NC joint
- *between Tib Ant and Tib Post*
- *! Saphenous veine and nerve = just dorsal*

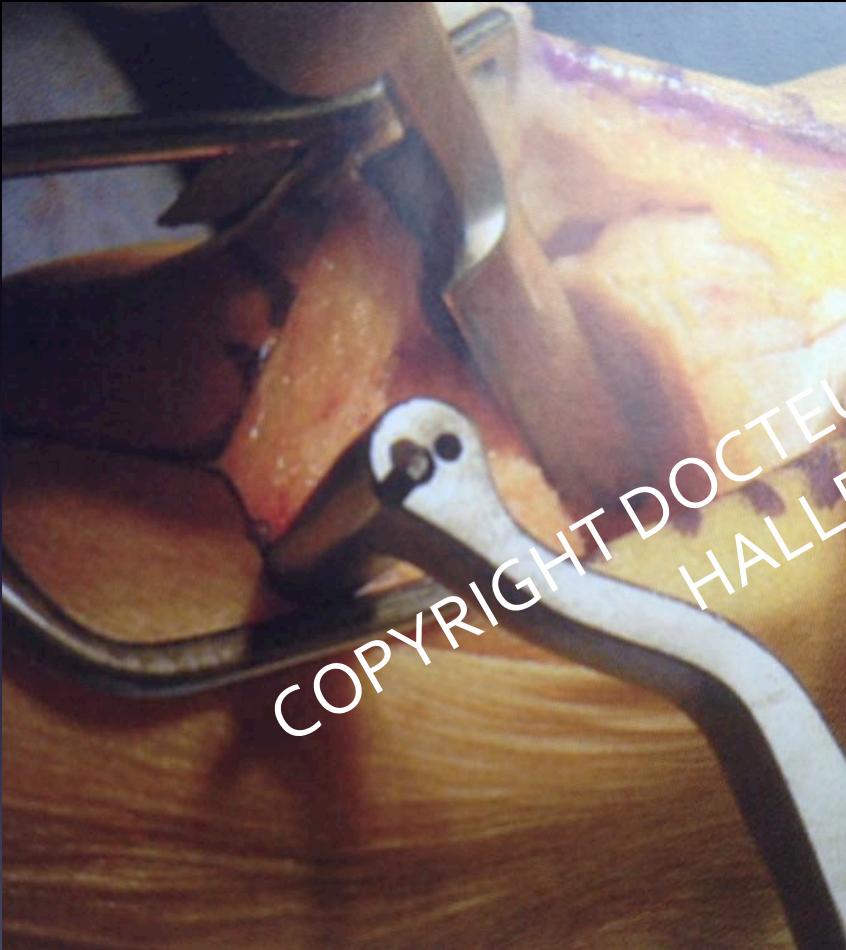
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cartilage TN removal
! No excessive dissection dorsally (blood supply talar neck)

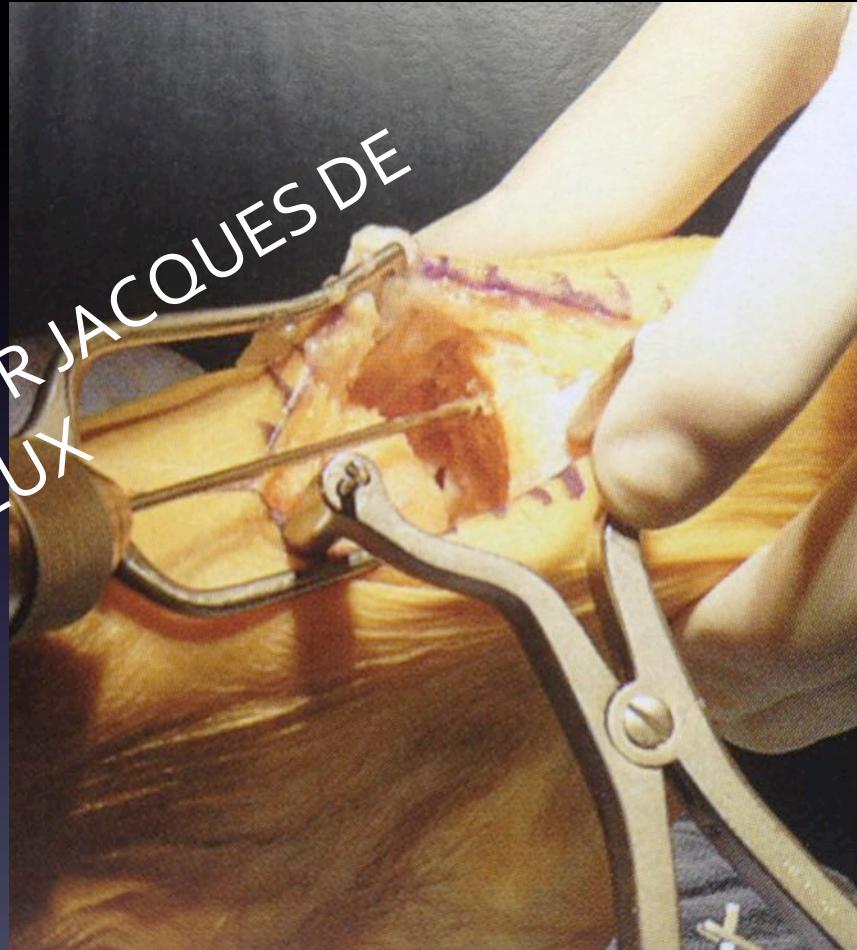


More extensive to allow lateral column lengthening (PPV)

cartilage navicularis removal



Pridie perforation



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