Ankle Fractures
Minimally Invasive Techniques to Avoid Complications

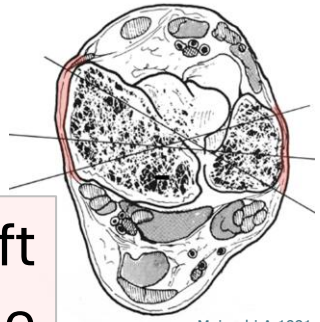
Christian Krettek, Hannover Germany

What are we talking about?

- Diabetic patients
- Open Fractures
- High-energy closed fx
- Elderly / frail patients

Trauma & patient risk factors for

- wound breakdown
- infection
- non-union
- impaired function


Maiocchi A 1991

... in an anatomic area with very thin soft tissue envelope

Why Minimally Invasive?

Have learned this from distal femoral fractures
which were up to the 1990 most problematic fx‘s for non-union

Idea: we cannot change the patient, nor the trauma,
but can change how we approach, dissect and deal with the bone
… always vascularity in mind …

- Reduce *additional* iatrogenic trauma
- Avoid soft tissue stripping
- Preserve biology as much as we can
- Maintain blood supply to the bone
- Lower risk for non-union and infection

… wishful thinking …
but the reality is often
otherwise …

Treatment Matrix

Situation	Preferred Strategy
Good soft tissue healthy	Plate … preferable in MIPO technique standard approaches (L,PL, M)
Poor soft tissue +++ comorbidities	Exfix & staged definitive fixation Intra-medullary fixation with … Threaded K-wire or Fibular nail
Frail bedridden	Joint transfixation Hindfoot nailing K-wires

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Minimally invasive Plate Osteosynthesis (MIPO)

Extraperiosteal Plating of Pronation-Abduction Ankle Fractures

By Jodi Siegel, MD, and Paul Tornetta III, MD

- Wait until soft tissue are ready.
  No tourniquet. Pillow under distal tibia, not calcaneus. Intraop Imaging CLside
- **Step 1:** start medial. Incision more antero-medial. Reduce the fracture, clamp or wire fix it tempoarily. Check direct + fluoroscopic control, and stabilize with bicortical lag screws. If vertical fx line … antiglide plate.
- **Step 2:** direct lateral incision, careful extraperiosteal dissection, soft-tissue sleeve surrounding the comminuted fracture fragments being left as intact as possible. Just the fx brim is cleaned.
- **Step 3:** Use contoured plate for reduction.
- **Step 4:** Manipulation of the foot towards the stable medial malleolus results in indirect reduction of the fibula due to the usually intact calcaneofibular ligament.
  So … reduction of the talus under the plafond pulles the distal part of the fibula out to length in most cases.

start with the medial malleolus

med. incision a bit more anterior

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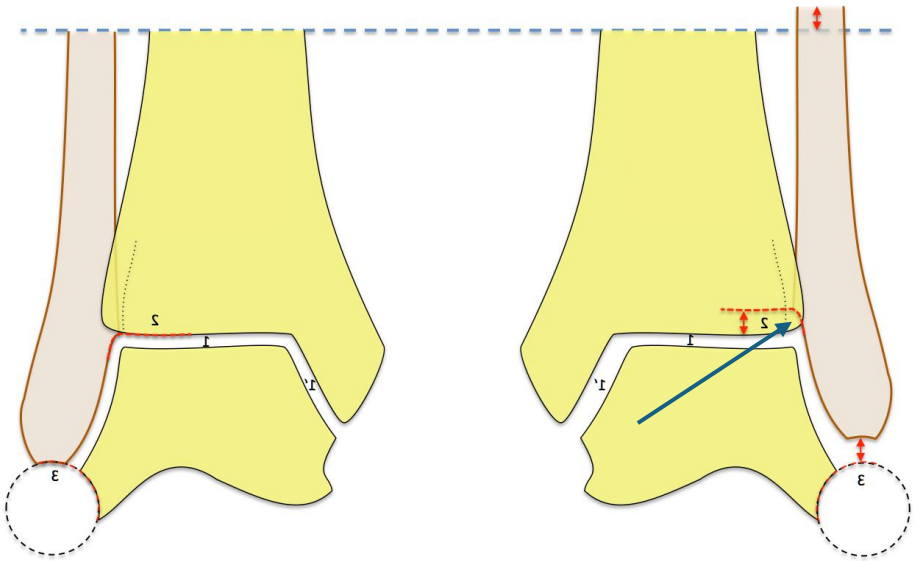
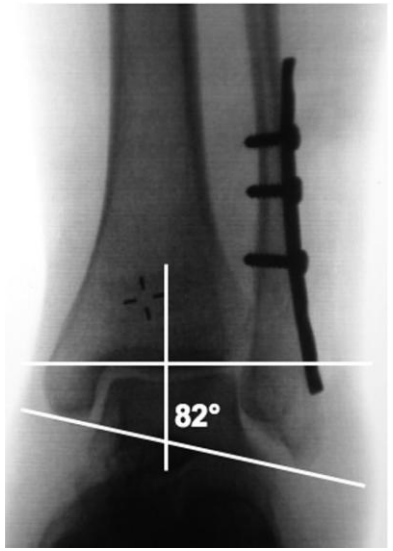
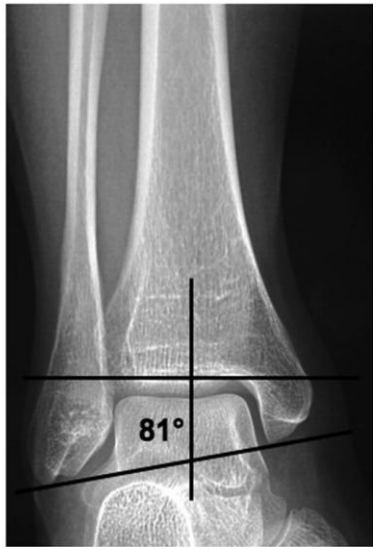
start with the medial malleolus

- **Step 5:** Length is confirmed by radiographic comparison with the normal side Radiographic landmarks are as the fibular notch and the talocrural angle.



Krettek et al Pilon fractures Der Chirurg 2015





talocrural angle

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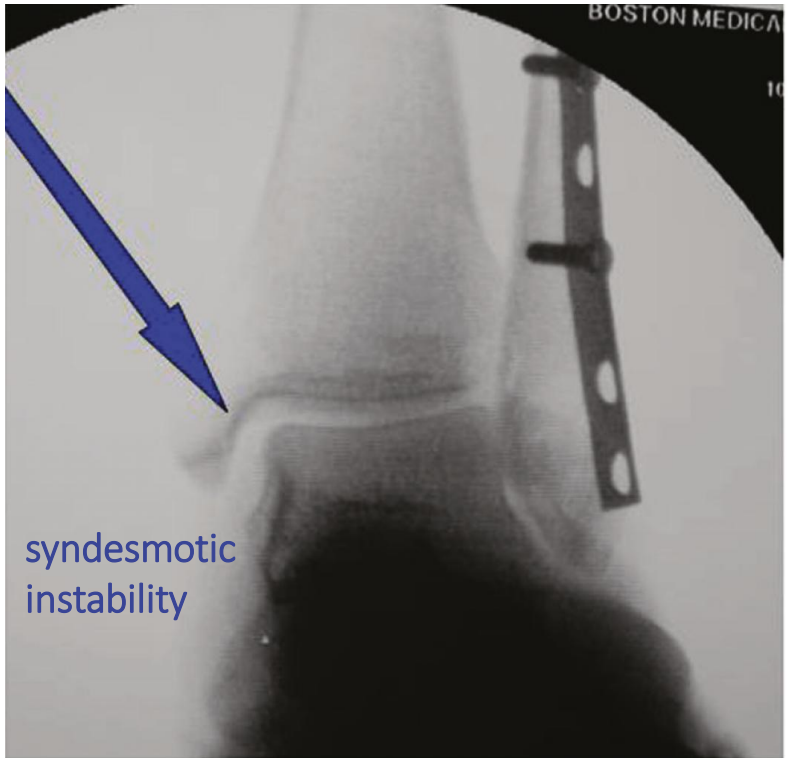
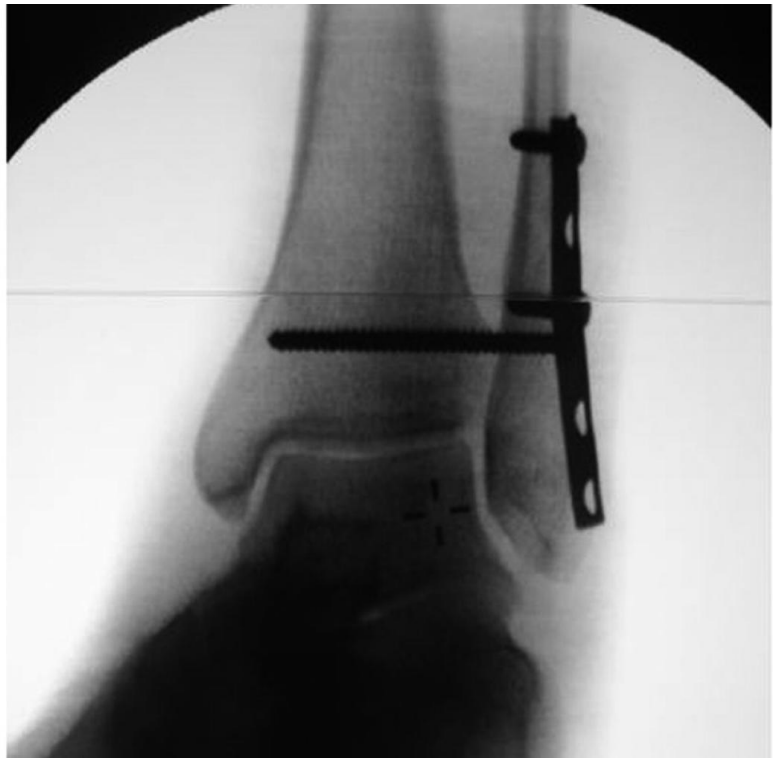
Step 6: Syndesmosis stress test. When the medial clear space and syndesmotic space are widened while the fibula remains anatomically aligned, this indicates syndesmotic instability.

This requires syndesmosis reduction, and a syndesmotic screw, here through the plate.

30 pts, FU 2.3y all healed <10w
no deep infections, AOFAS 82





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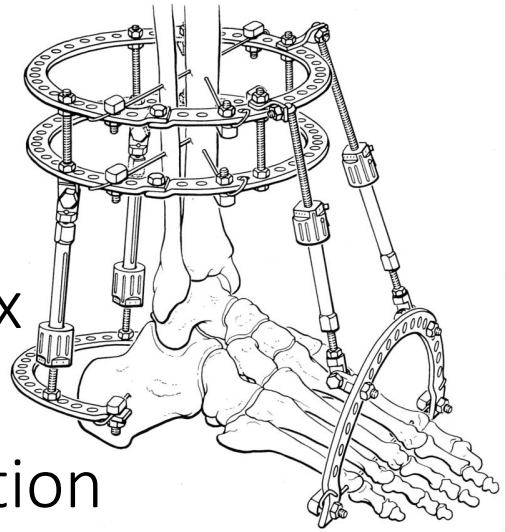
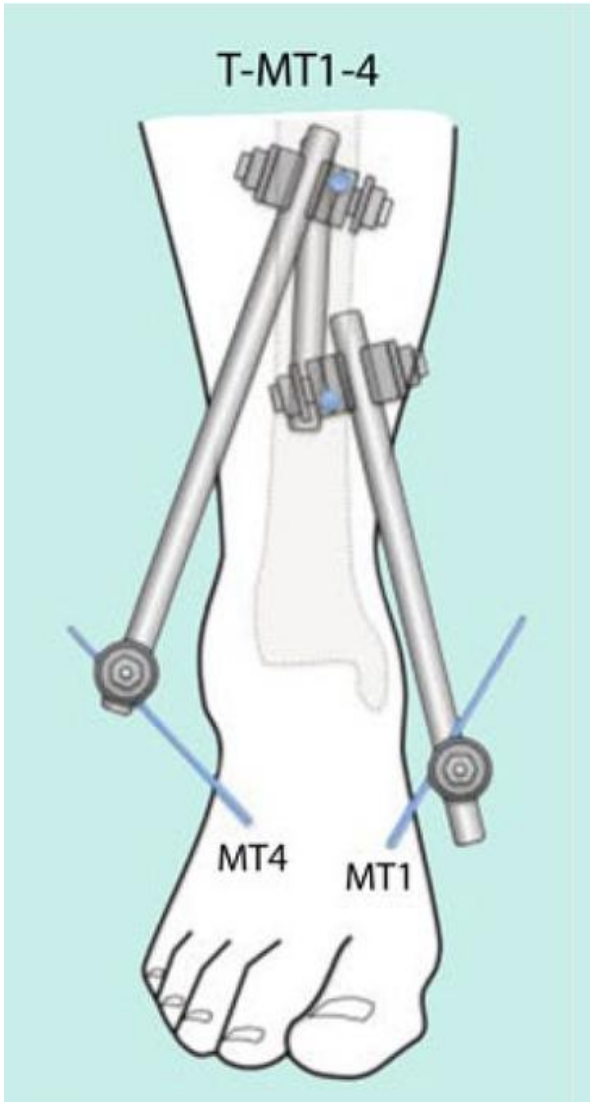
External fixation and staged definitive fixation

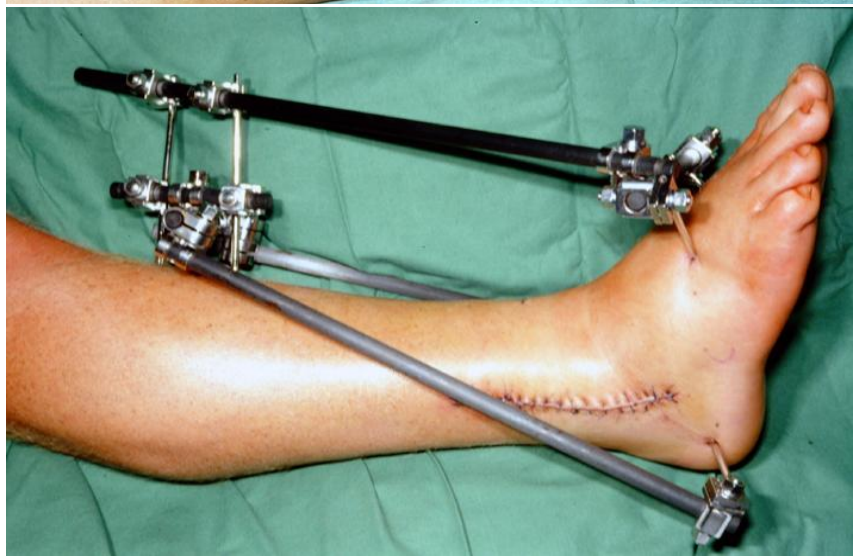
- Tibio-MT1-4 construct
- radiolucent carbon bars
- 2 tibial pins (prevent rotation)
- ExFix can act as reduction tool
- make sure, connectors are not projected to the ankle joint space

- ring fixator more complex to arrange but viable option



Laughli RT et al. 1995





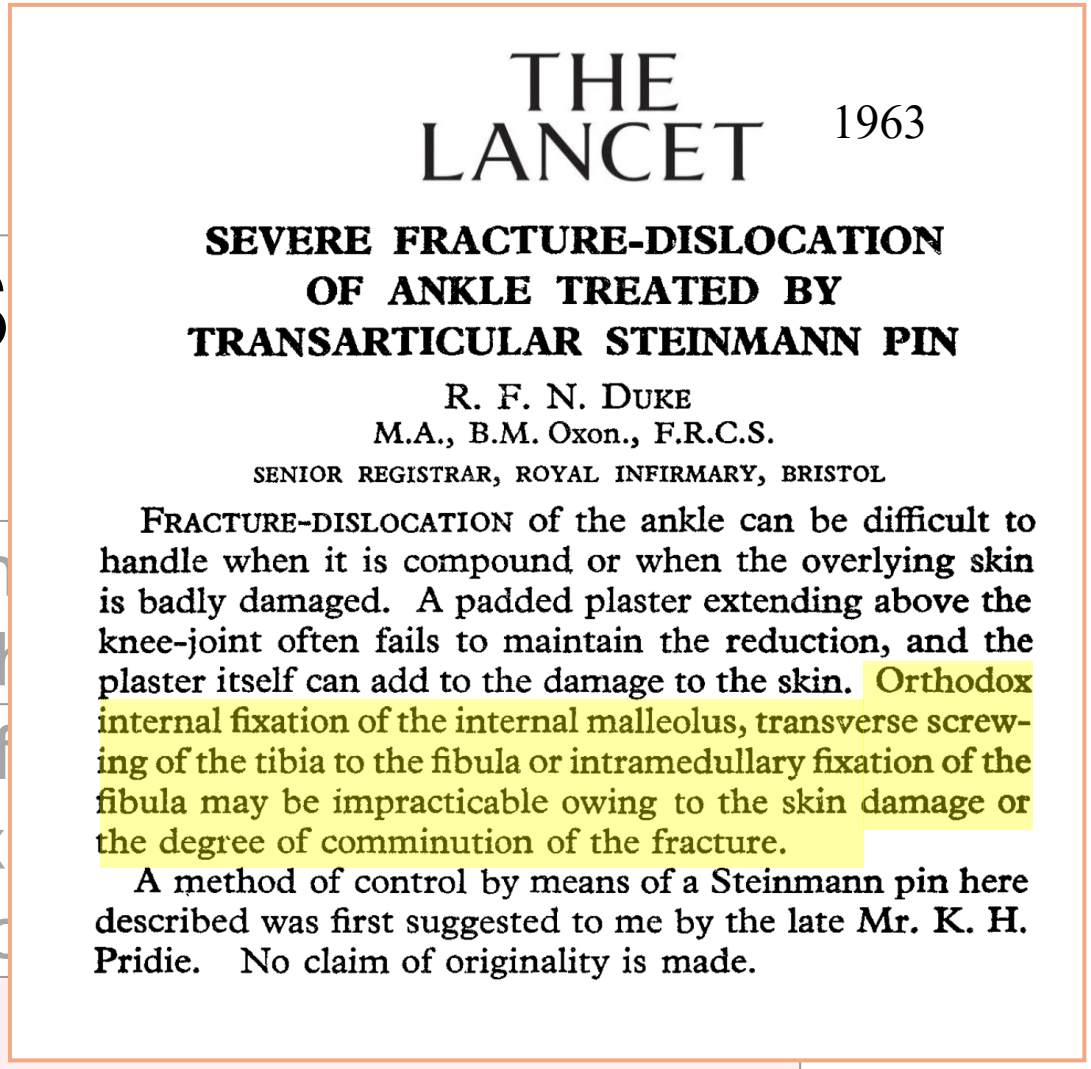
IM Fixation of the Fibula

Starting point defines alignment
if fragments are displaced, they need to be reduced
before fixation or
careful planning is required to achieve
the alignment by the nail … starting point often too lateral

IM Fixation of the Fibula

Treatment Matrix

Situation	Preferred S
Good soft tissue healthy	Plate preferable in standard approach
Poor soft tissue +++ comorbidities	Exfix & staged def Intra-medullary fix Threaded K-wire c
Frail bedridden	Joint transfixation Hindfoot nailing St-Pins & K-wires



THE LANCET 1963

SEVERE FRACTURE-DISLOCATION OF ANKLE TREATED BY TRANSARTICULAR STEINMANN PIN

R. F. N. DUKE
M.A., B.M. Oxon., F.R.C.S.
SENIOR REGISTRAR, ROYAL INFIRMARY, BRISTOL

FRACTURE-DISLOCATION of the ankle can be difficult to handle when it is compound or when the overlying skin is badly damaged. A padded plaster extending above the knee-joint often fails to maintain the reduction, and the plaster itself can add to the damage to the skin. Orthodox internal fixation of the internal malleolus, transverse screwing of the tibia to the fibula or intramedullary fixation of the fibula may be impracticable owing to the skin damage or the degree of comminution of the fracture.

A method of control by means of a Steinmann pin here described was first suggested to me by the late Mr. K. H. Pridie. No claim of originality is made.

Hindfoot nailing vs ORIF in neuropathic ankle fx

Foot & Ankle Orthopaedics
2026, Vol. 11(1) 1–11
© The Author(s) 2026
DOI: 10.1177/24730114261425629
journals.sagepub.com/home/fao

Retrospective Comparison of Complication Rates Following Tibiotalocalcaneal (TTC) Nail Fusion vs ORIF for Neuropathic Ankle Fractures

Spencer C. DeMedal, MS[1], Kelly Dopke, MD[2], Kelan Queenan, BS[1],

US Study
subgroup of neuropathic pts.
pose a +++ risk for complications

45 pats, 26 ORIF (100% diabetics) vs
19 TTC fusion (90% diabetics)

only difference
earlier WB @2 weeks: 19% ORIF vs 63% TTC fusion ($p<0.05$)

all other time points, complications or medication: no difference
like … reoperation ORIF: 54% TTC (56%)

Hindfoot nailing with long retrograde nails

THE BONE & JOINT JOURNAL

■ TRAUMA

Fragility fractures of the ankle in the frail elderly patient

TREATMENT WITH A LONG CALCANEOTALOTIBIAL NAIL

S. Al-Nammari et al, JBJS-B 2014, St George's Hospital, London

48 pats, 82y, ASA 3,
all frail, mult. comorbidities, no independant walker
all fx's displaced and unstable
94% low energy … 40% open,
overall mortality @6m 35%

deep infections 2%
broken screw 6%
valgus malunion 4%
1 bk amputation (vascular problems)
no non-union, nail brakage, or peri-implant fx

Hindfoot nailing

Abdulsattar et al. 2025
Hindfoot Nailing for Ankle Fractures in High-Risk Elderly Pats
A Retrospective Analysis
Cureus 17: e96358. doi:10.7759

58 pats 80y, 81% female
Rockwood frailty score 5.4
ASA 3.10, 24.6% diabetics
open fx 64% (… 63% complications vs 18%)

- 1y mortality 21%, overall union rate 80.0%
- Joint preparation +++ complication (65% vs 23%)
  … but similar union rates (~ 80%)
- Functional mobility 50% declined
  40% same / 10% better

Expert Hindfoot Arthrodesis Nail (DePuy Synthes)

Talo-tibial Transfixation

82 y female, bedridden since a year, severe dementia

compromized soft tissue medial and lateral

2 x 2.5mm threaded K-wire in LA

2 weeks after pinning, wrinkeling of skin

3m FU, died 9 months later

∑ simpel, easy, effective, no anaesthesia

Take-Home Message Minimally Invasive Ankle fx Techniques

Situation	Preferred Strategy
Good soft tissue healthy	Plate preferable in MIPO technique standard approaches (L,PL, M)
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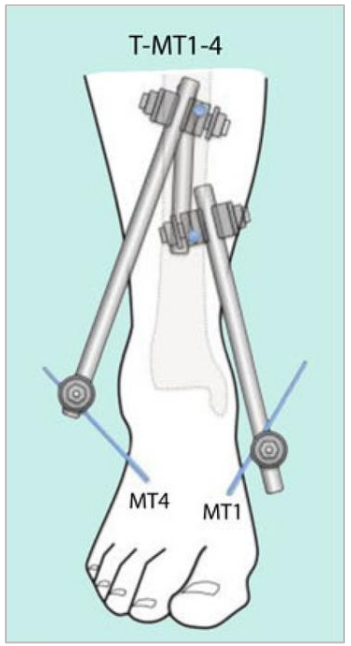
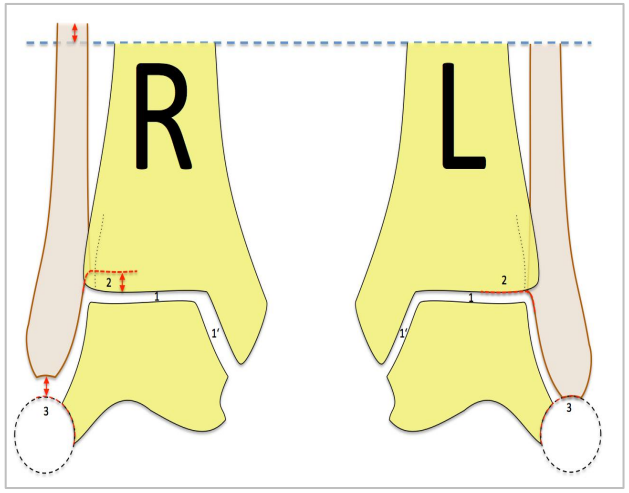
- We cannot change the patient and the trauma … but we can change the soft tissue management
- 3 Level Decision Maxtrix
- MIPO ankle … stepwise approach
  medial malleolus first
  align approach to reduction … not the implant
  know the reduction mechanics & landmarks
- Retrograde IM fixation fibula … various options incl. simple & effective lowcost implants
- Hindfoot nailing for the multimorbid low-demander
  No resection of art. cartilage comorbidity





Minimally invasive Plate Osteosynthesis (MIPO) modified

multimorbid patient
Diabetes, AVK, renal failure
displaced ankle joint

Minimally invasive Plate Osteosynthesis (MIPO) modified

Minimally invasive Plate Osteosynthesis (MIPO) modified

Fibula (MIPO / percutaneous plating)

- small incision distal + proximal
- subcutaneous plate insertion
- indirect reduction

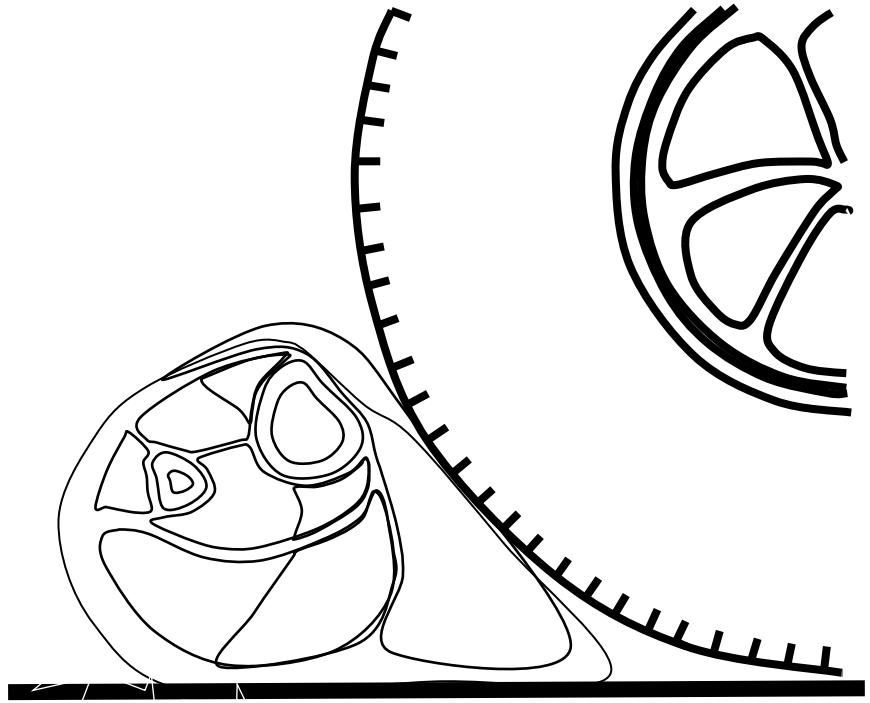
👉 Key points:

- alignment over perfect visualization
- fluoroscopy-driven

2. Why Do We Get Complications?

- Swelling / timing issues
- Large surgical exposure
- Soft tissue dissection / retractors
- Hardware irritation

Spectrum of soft tissue injuries

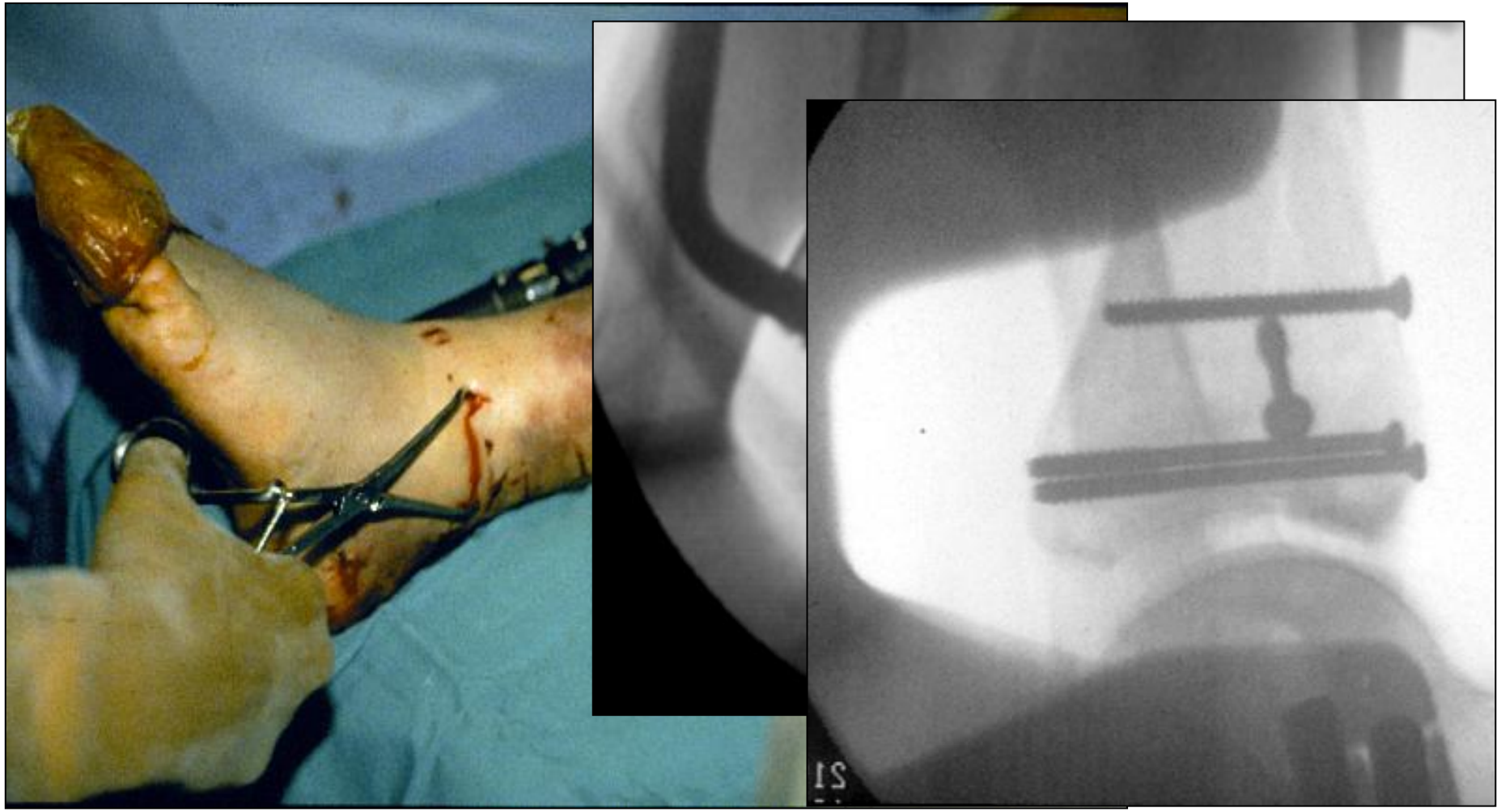


5 Things to consider

1. Visualization of the articular reduction / approaches
2. Delay until definitive surgery
3. Spanning fixation
4. Fixing the fibula
5. Ankle motion

1. Visualization of articular surface

Percutaneous (C-arm controlled 2D)



1. Visualization of articular surface

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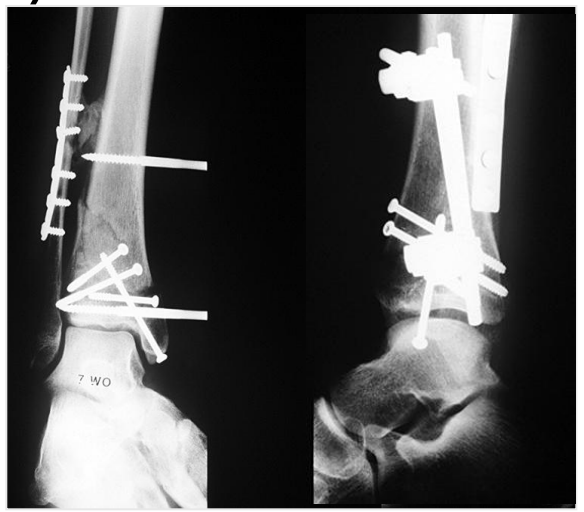
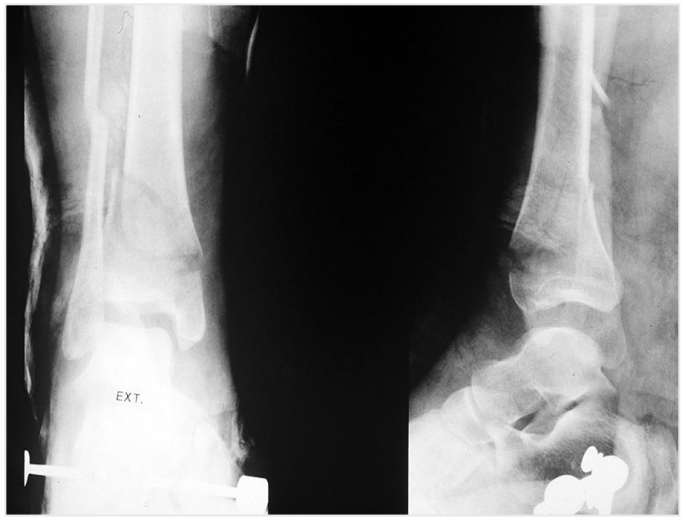




Soft Tissue Injury

Red Blisters

Clear Blisters

Open Fractures

MHH protocol for pilon fxs

1. Exfix day 0
   ± fibula fixation

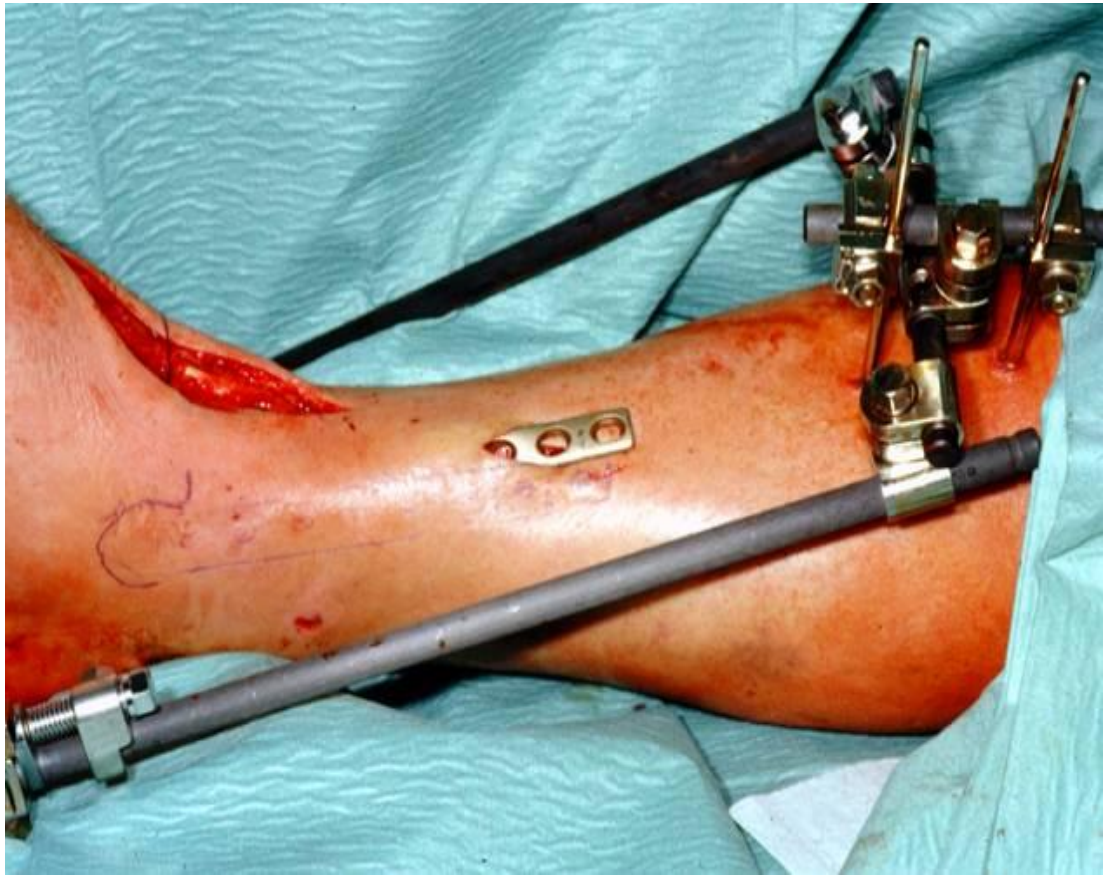
MHH protocol for pilon fxs

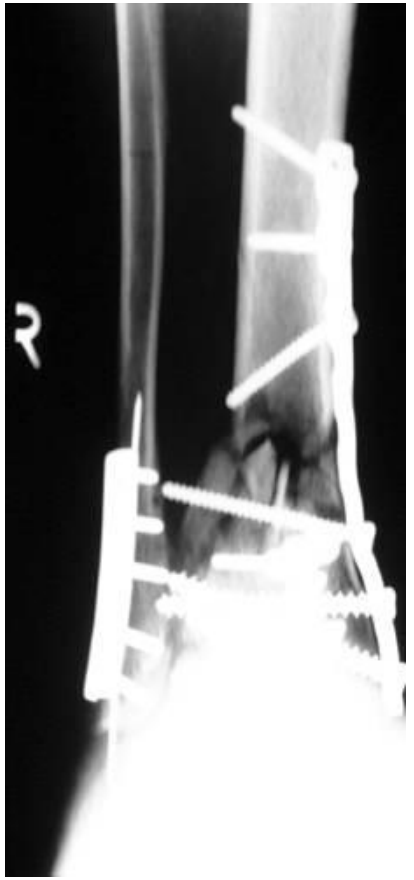
1. Exfix day 0
   compartment release?
   ± fibula fixation (plate / im)
2. Soft tissue monitoring
3. CT (after exfix), planning

MHH protocol for pilon fxs

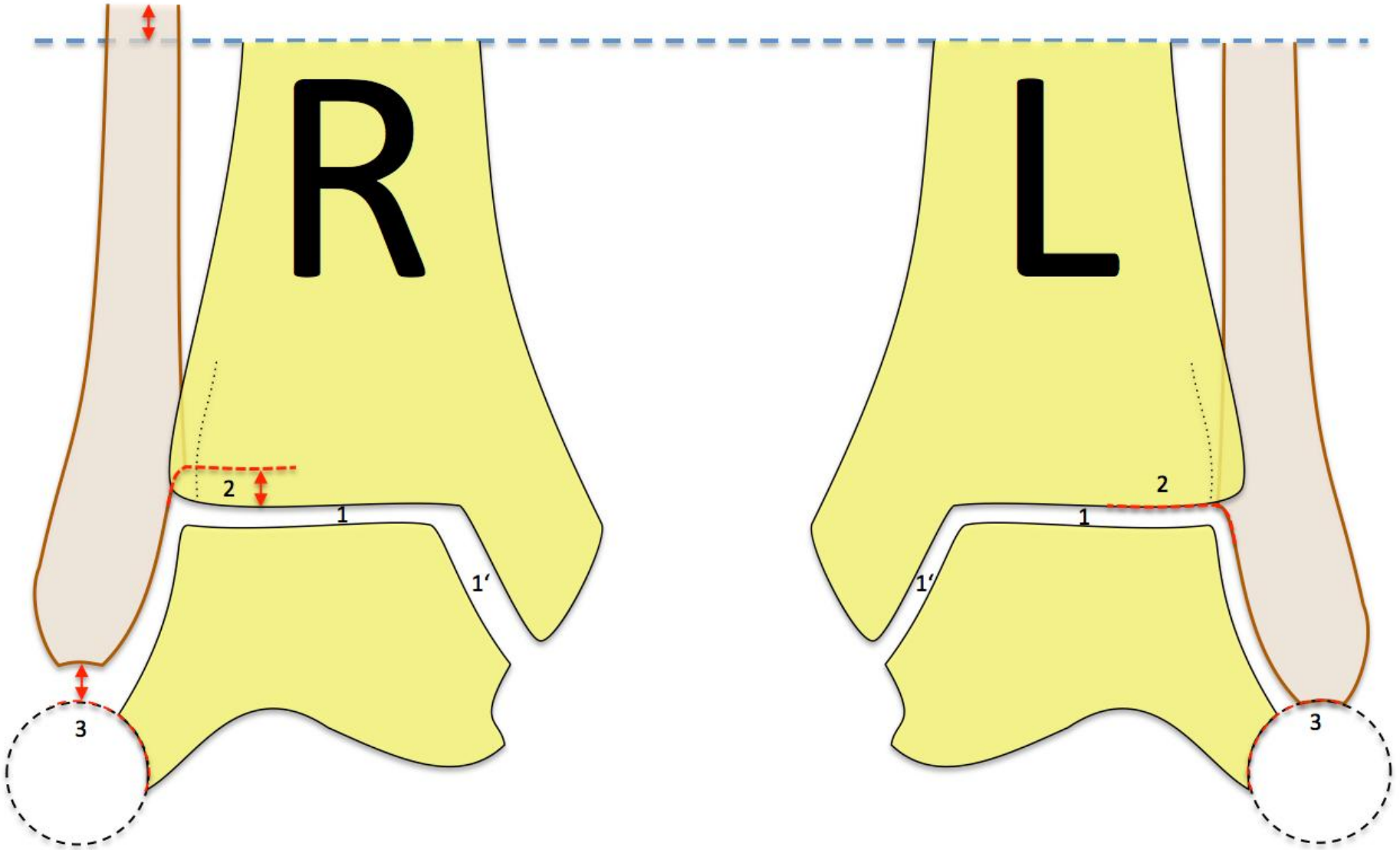
4. Definitive surgery (day 7–21)

    approach fracture adapted/limited





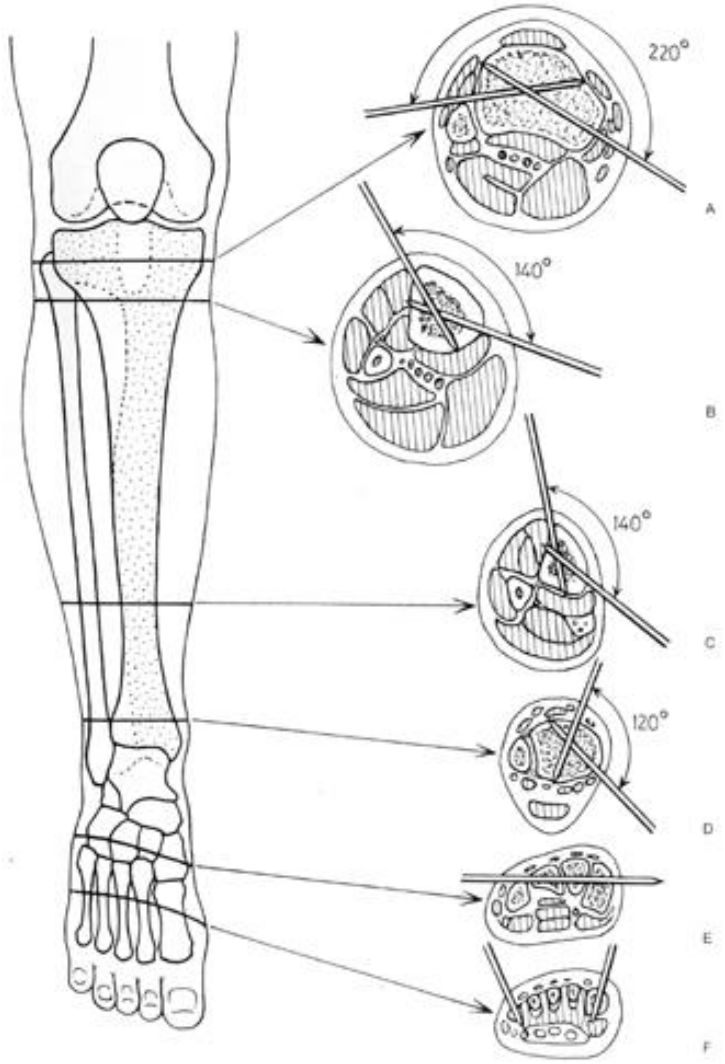
gth

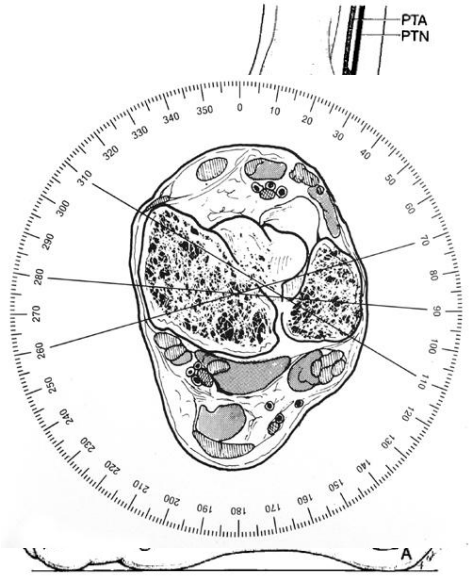


Krettek et al Pilon fractures Der Chirurg 2015

Fracture
Soft-tissue
Correction
Summary

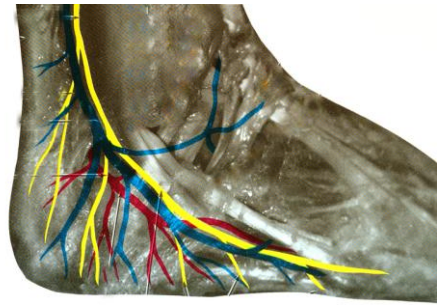
Anatomic considerations
Pin-Placement





Casey D et al. JOT 2002

Maiocchi A 1991

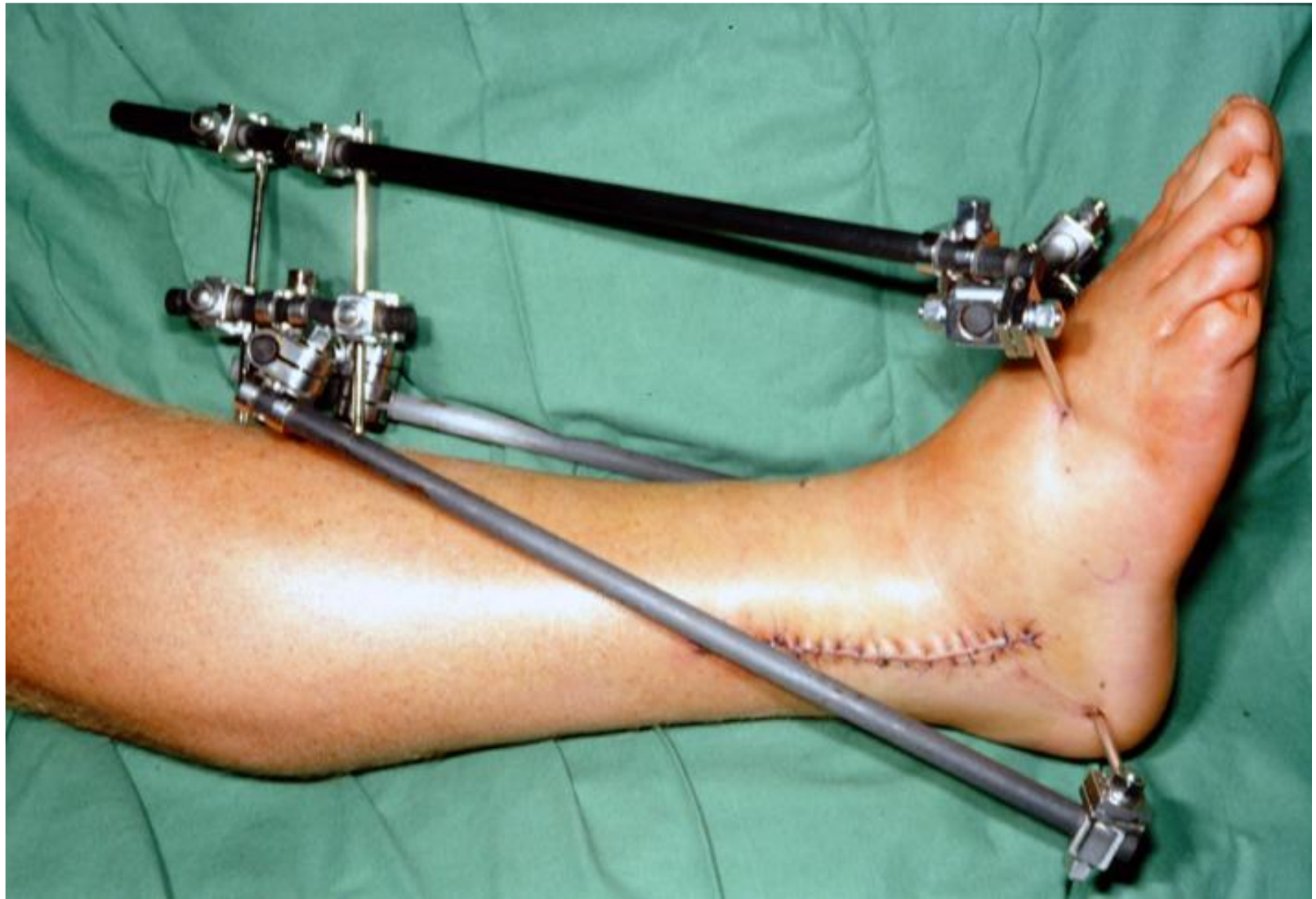


Sarrafian 1993

Example

Tibio-Metatarsal Fixation

for pilon fx



Example

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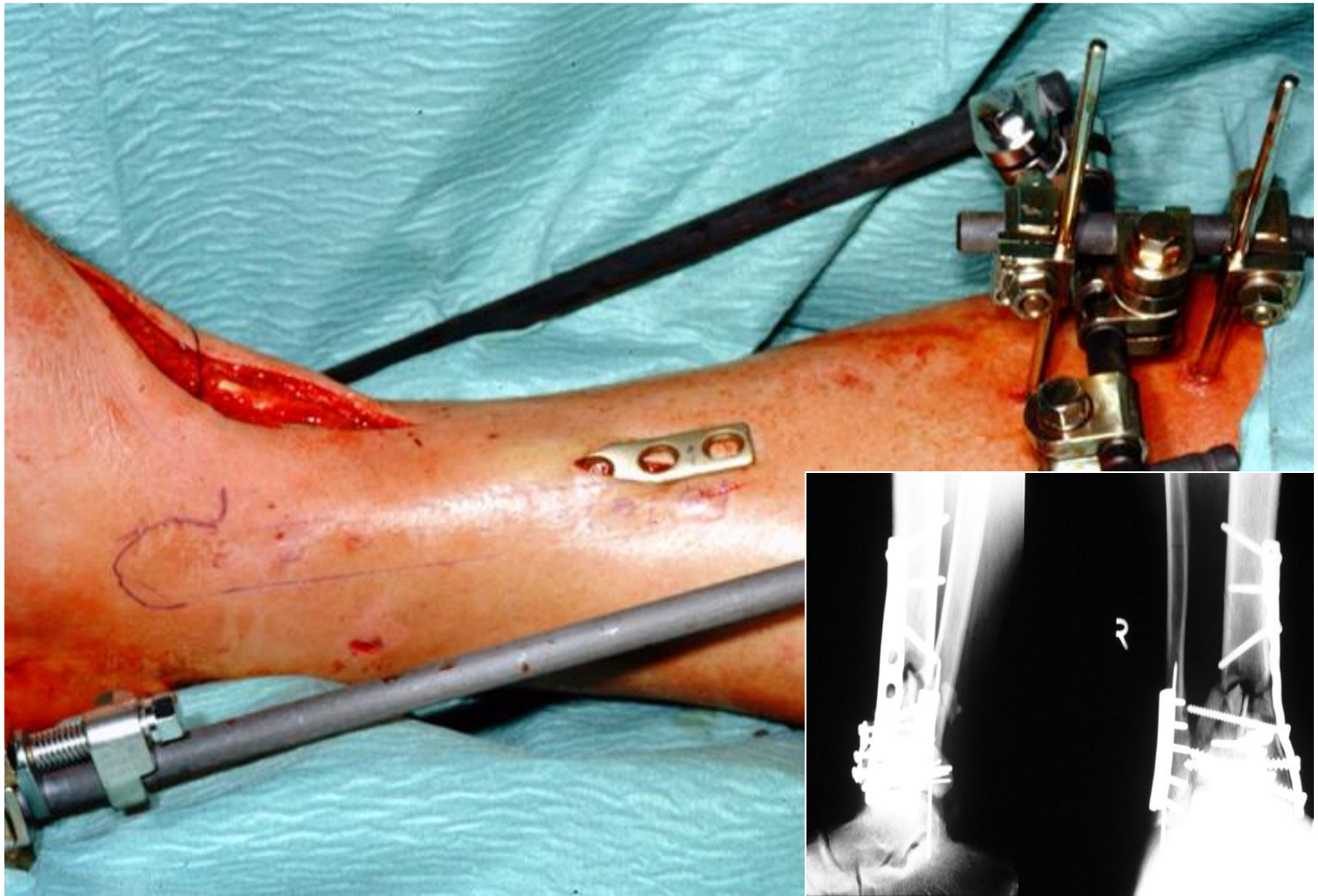


Example

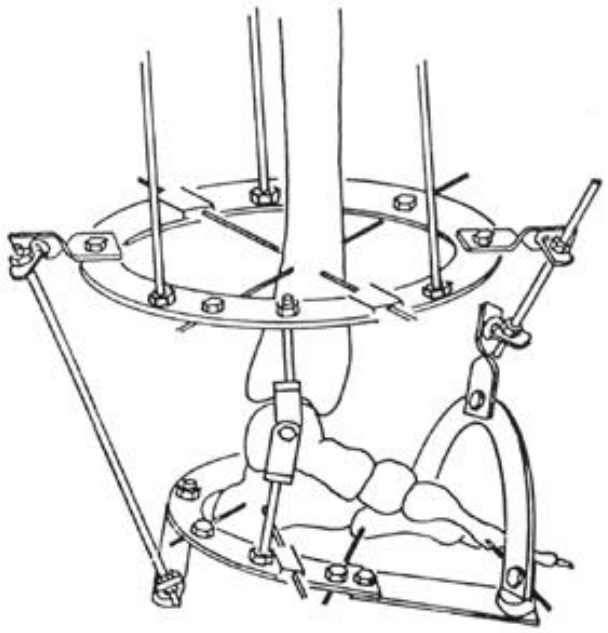
local additive fixation

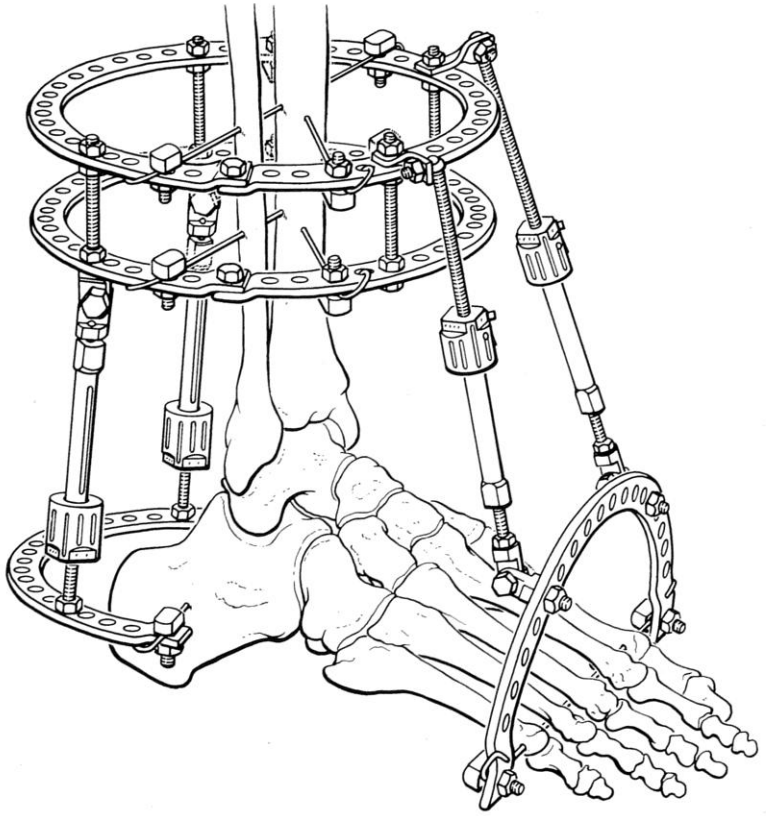
for ankle fx dislocation

Corrective surgery

Continuous distraction

Pes equinus





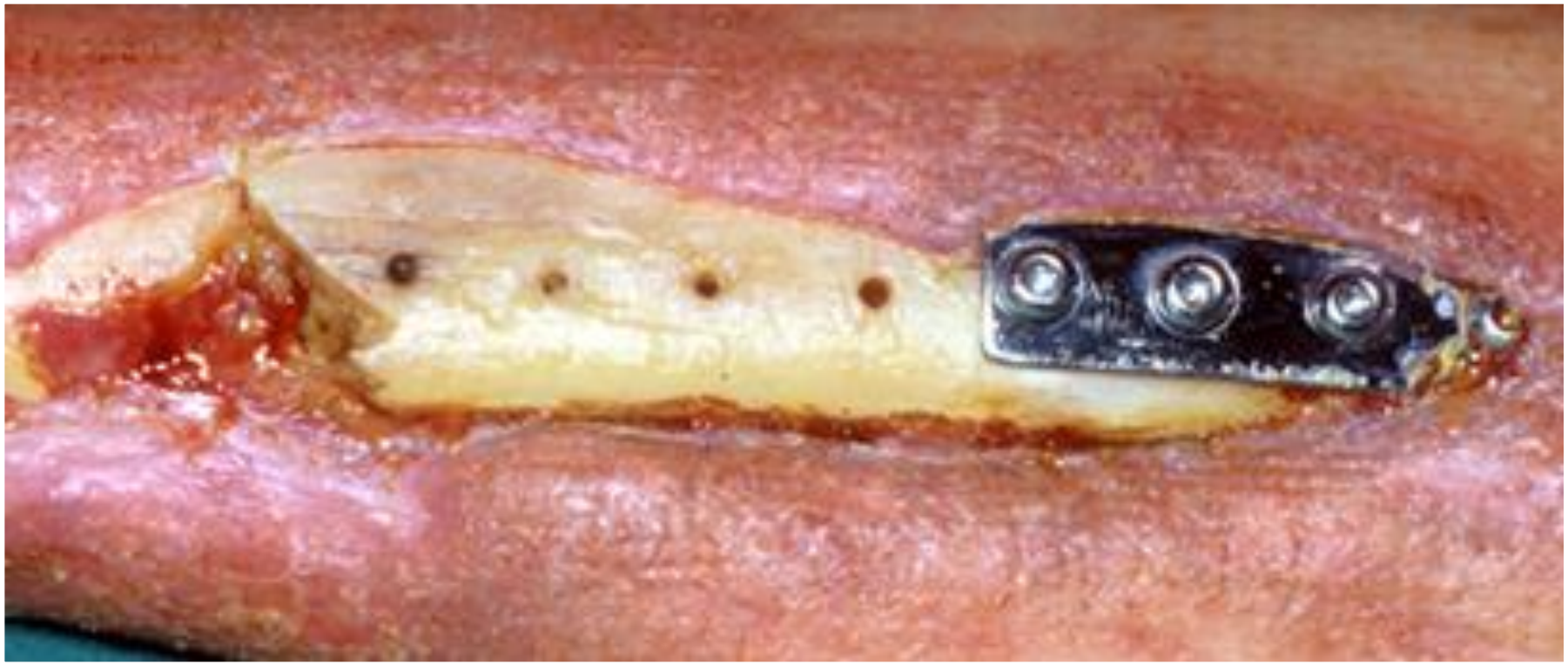
Maiocchi A 1991

Laughli RT et al. 1995

Soft tissues

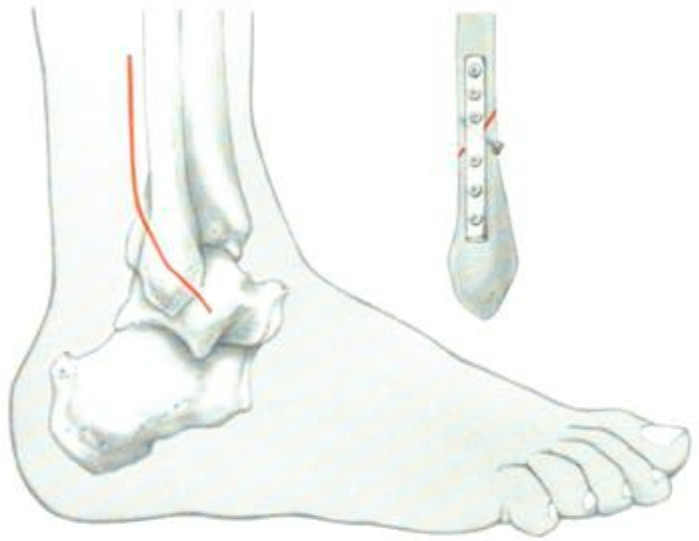
- consider derrnato-fasciotorny
- temporary wound coverage
- early involvernent plastic surgeon
- ... be patient ...

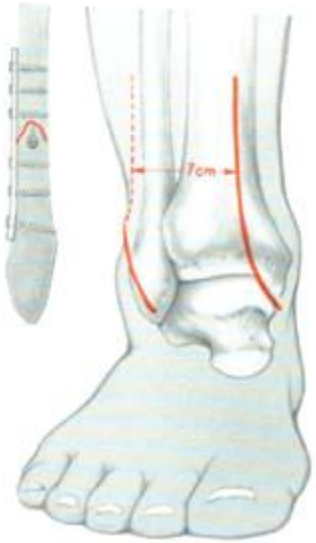
konventionelle Plattenosteosynthese proximale Tibia



Incsisions

- Posterolateral approach (fibula)
- Anterior median incision (tibia)
- Medial incisions (some B-types)
- soft tissue bridge > 7 cm
- full thickness flaps



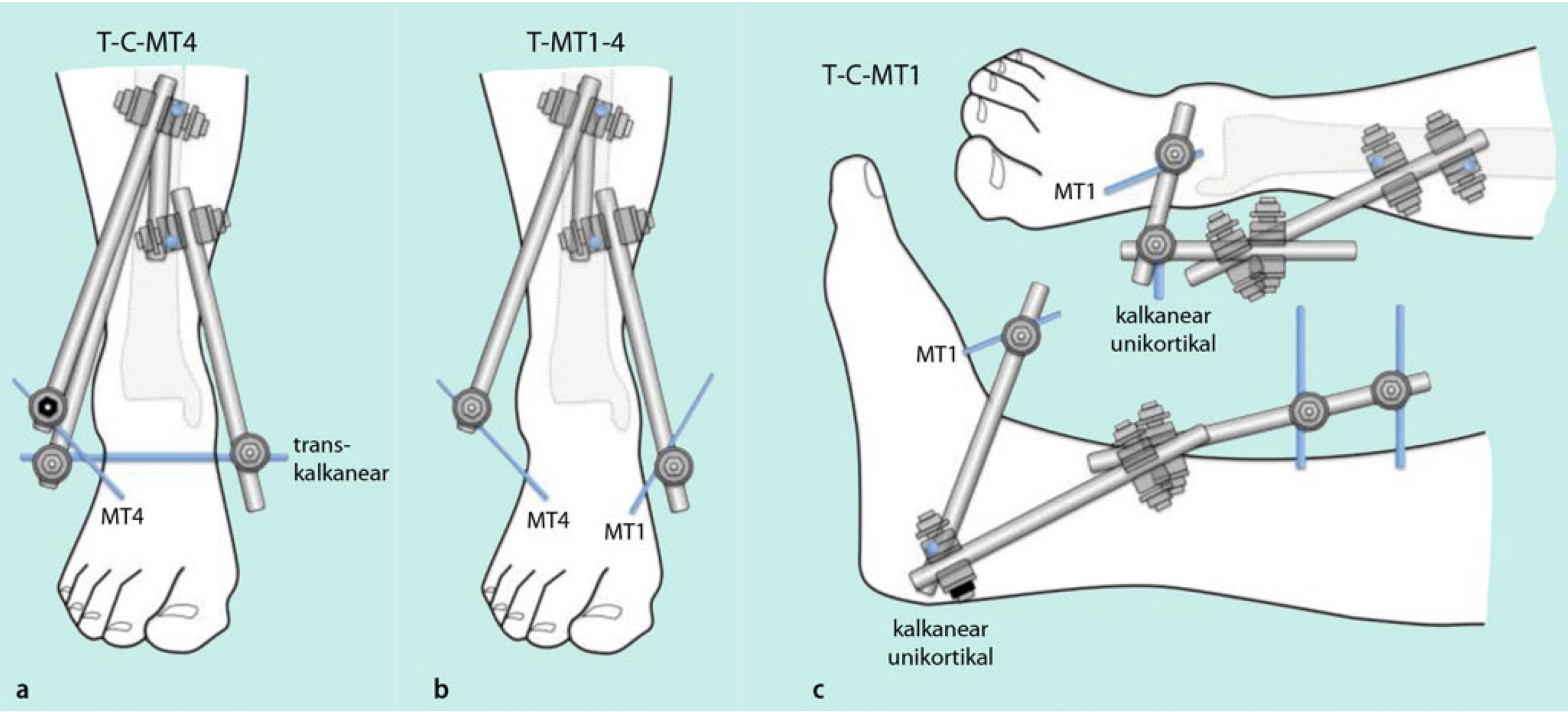


TP Rüedi, M Allgöwer CORR 1979
J Mast Tech Orthop 1987

2 DCO Temporary ExFix – 3 Configurations

simple

complex



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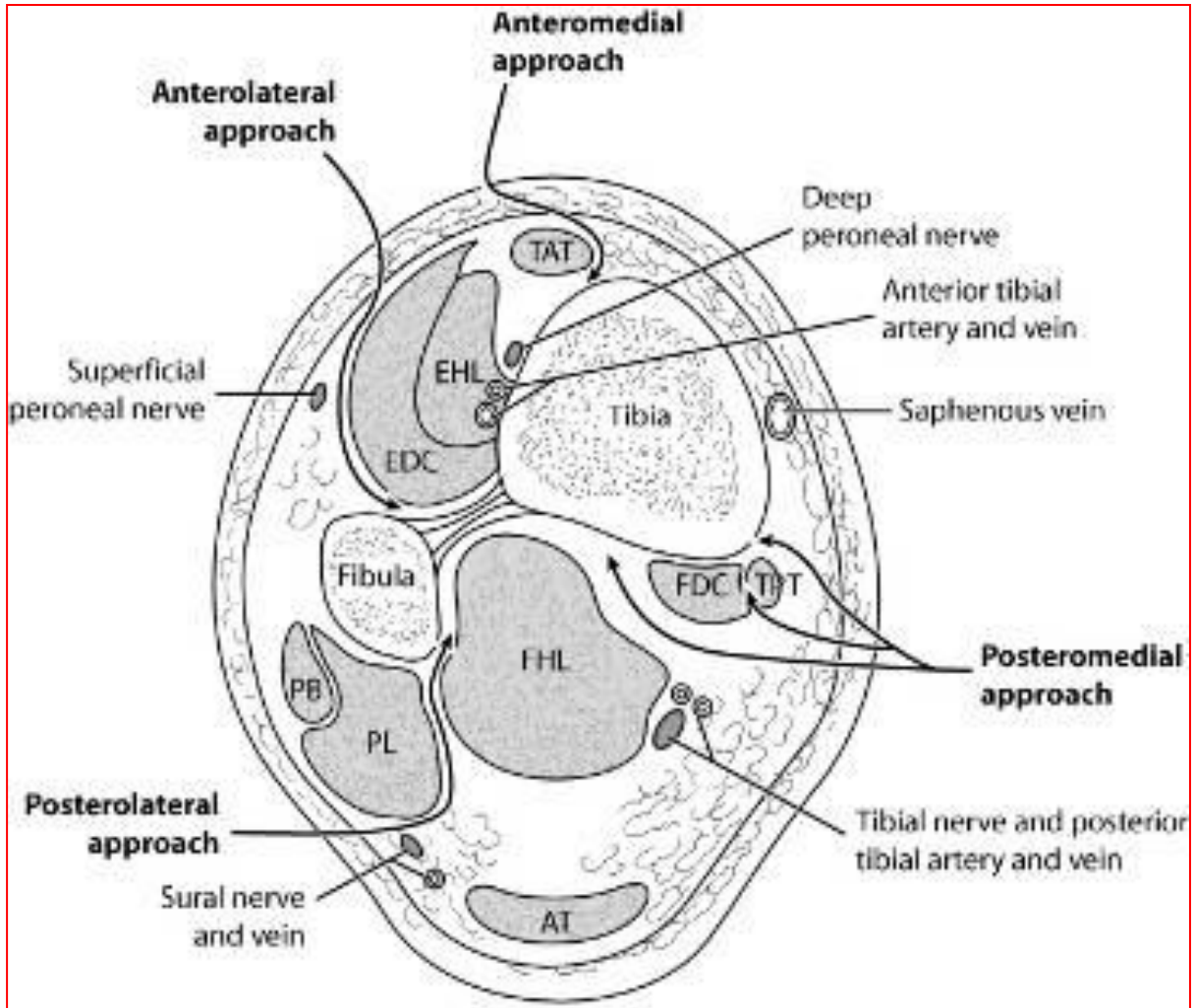
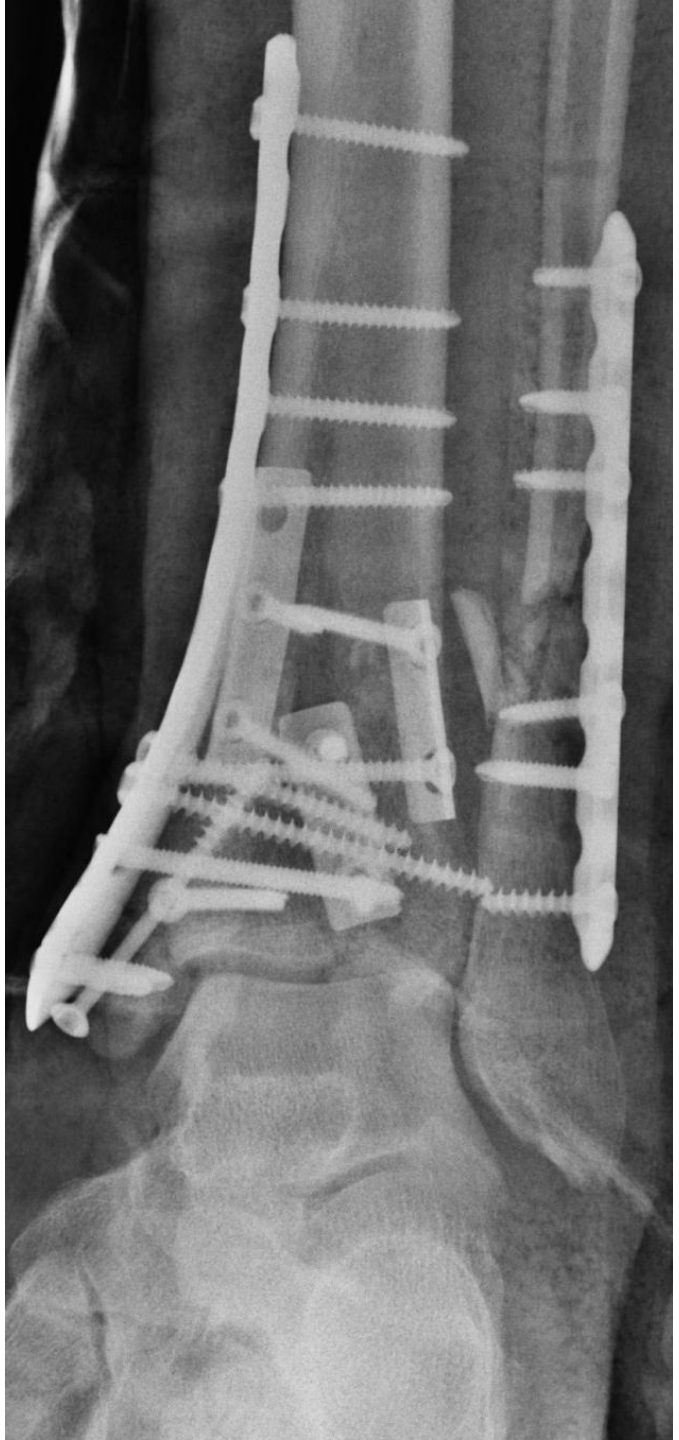
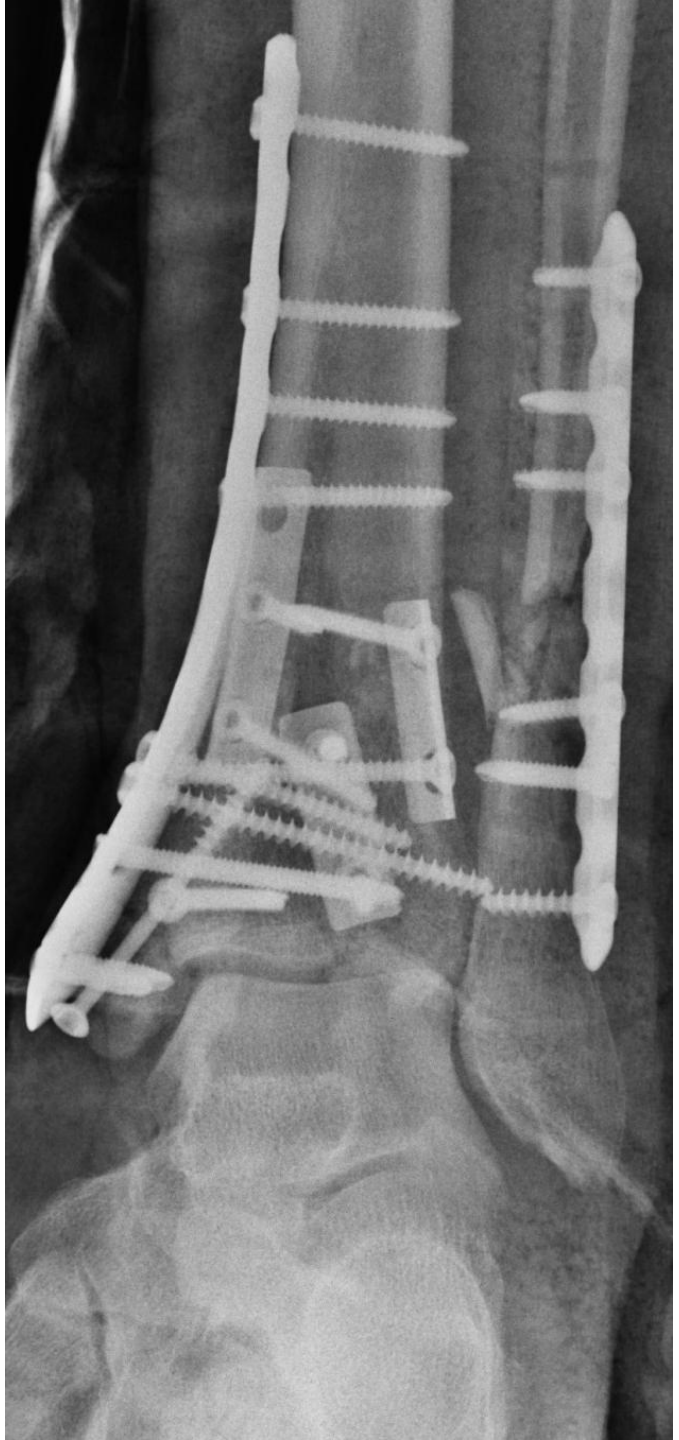


AT Achilles tendon
EDC Extensor digitorum communis
EHL Extensor hallucis longus
FDC Flexor digitorum communis
FHL Flexor hallucis longus
PB Peroneus brevis
PL Peroneus longus
TAT Tibialis anterior tendon
TPT Tibialis posterior tendon

Posterolateral Approach





Mobilization

- “Most disability that occurs following a fracture is related to the treatment and not to the pathology.”
- “I believe prolonged immobilization is harmful.The patient should be encouraged to move his diseased joints in spite of pain and discomfort”

G. Perkins. Rest and Movement. JBJS(B), 1953