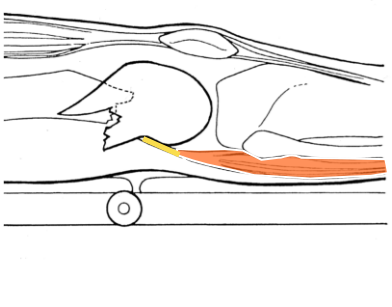
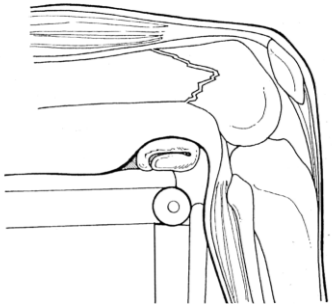
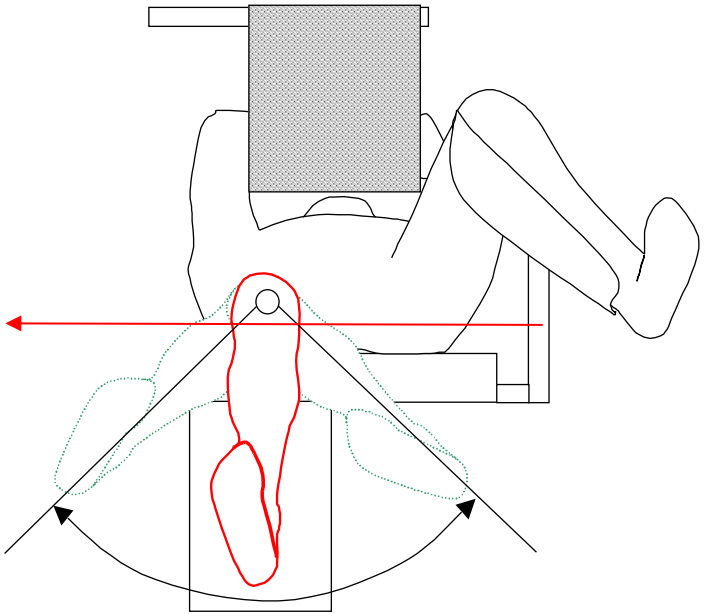
Distal Femur Fractures - A Stepwise Approach to Fixation

Preparation

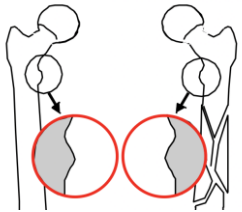
- supine, radiolucent table
- Knee flexion / bolster
- good C-Arm, large field, 2 monitors
- get contralateral leg out of C-arm beam
  - Obstetric leg holder or
  - elevate ipsilateral leg &
    lower contralateral side & rotate table
- Entire leg draped
- No tourniquet



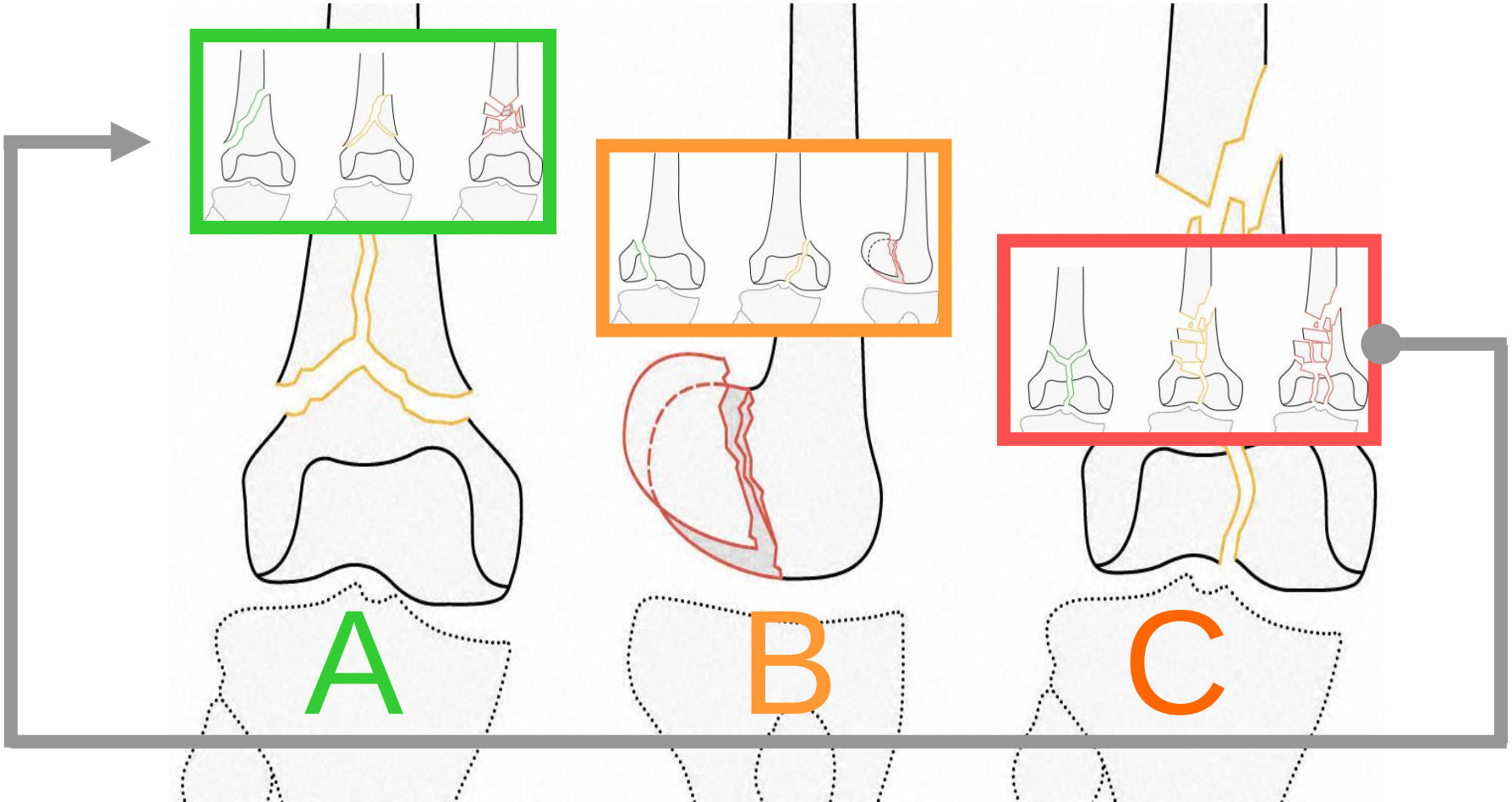




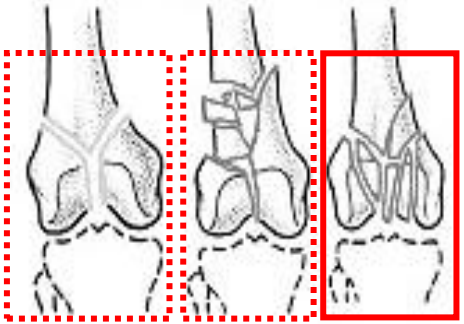
- check contra-lateral side
  lenth / ROM Hip joint
  hyperextension test
  lesser troch shape

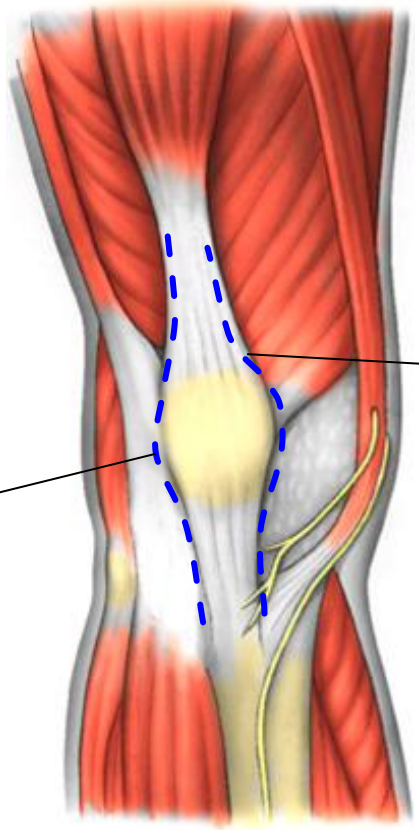


Classification guides the approach



Approach





1. lateral parapatellar
   C1-C3 Type
   lateral B2 (Hoffa)

2. medial parapatellar
   medial B2 Type (Hoffa)

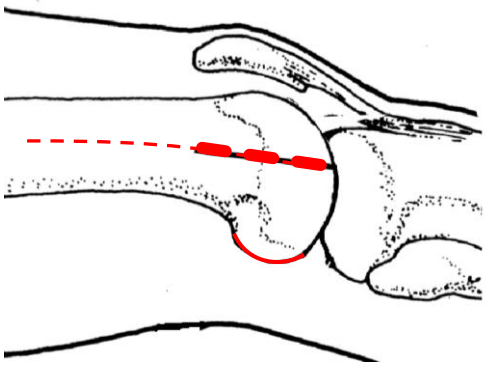
TARPO

Transarticular Approach & Retrograde Plate-Osteosynthesis

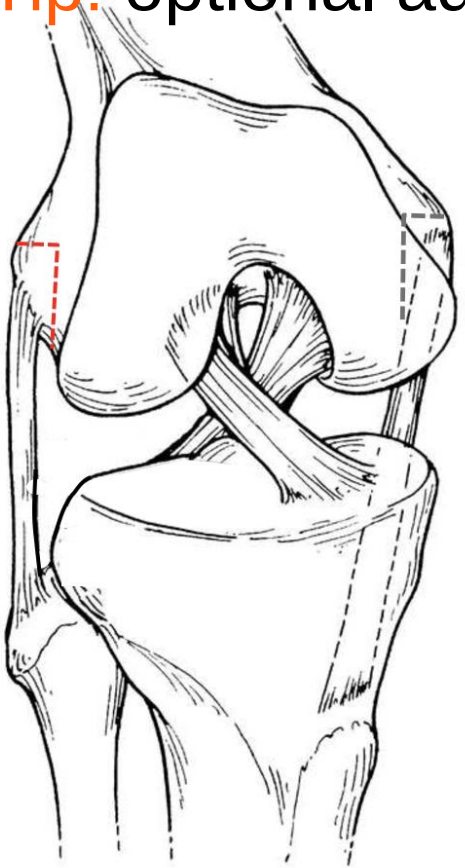
Krettek, Miclau, Tscherne et al (1997) Injury 28:31

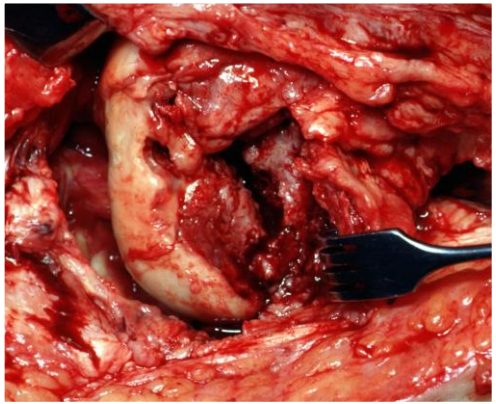
keystep:
lateral
parapatellar
arthrotomy

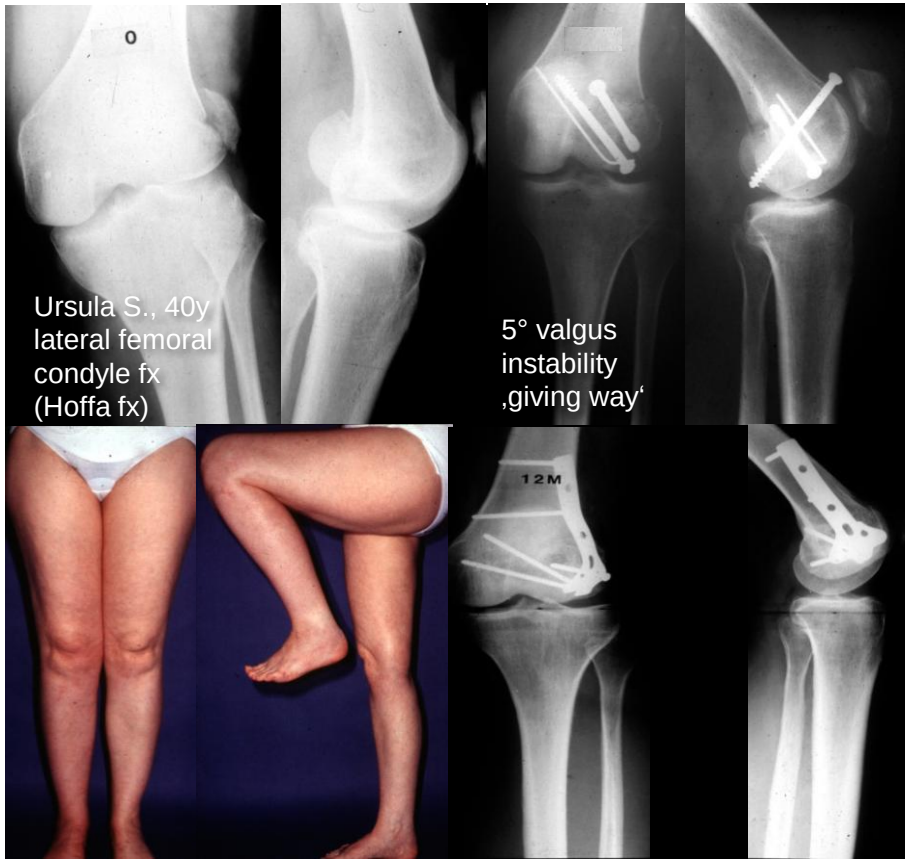
2. Direct Lateral Approach (A-types, undisplaced C1 Fx)



Tip: optional additional epicondyle OT (B type fx)

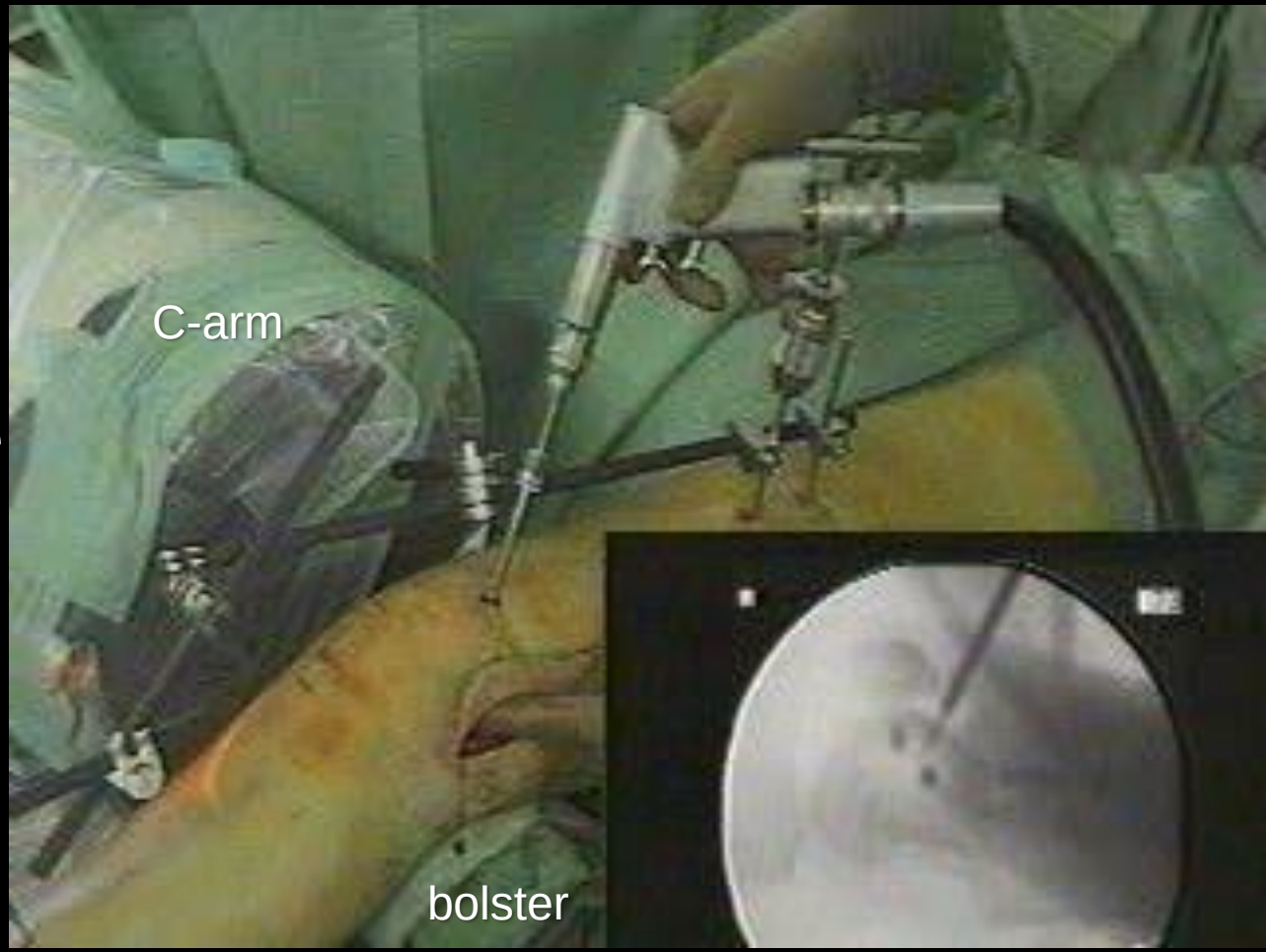




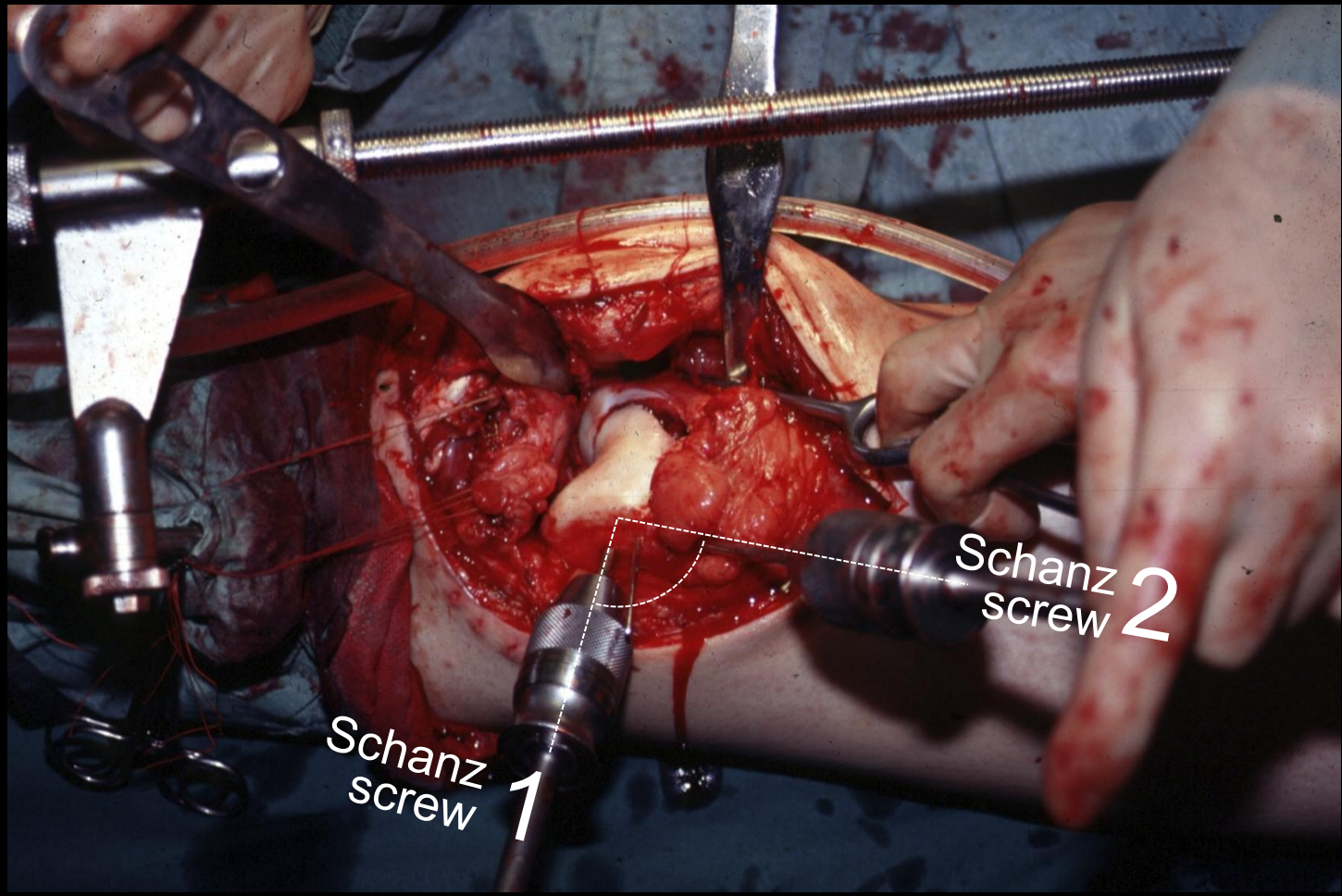


reduction aids

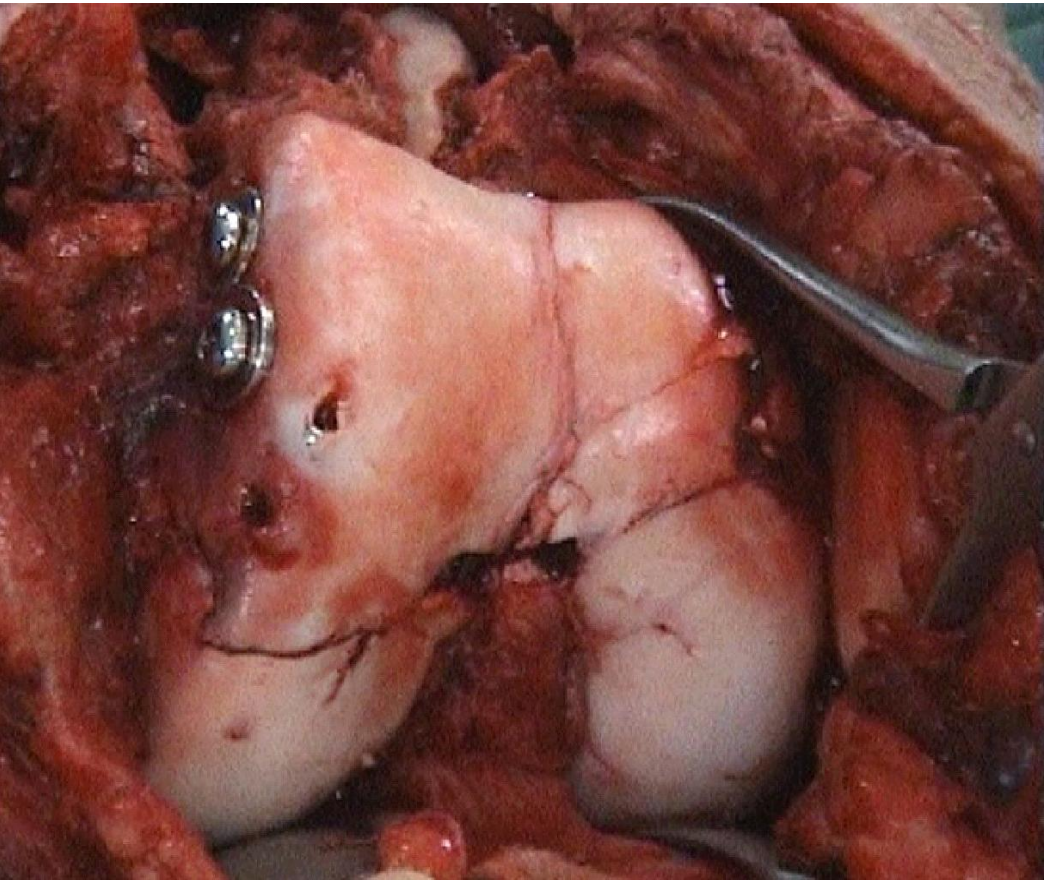
ExFix
Schanz screws
T-Handle
1 Joystick: biplanar manipulation
3rd plane unreliable
(Schanz screws can rotate)

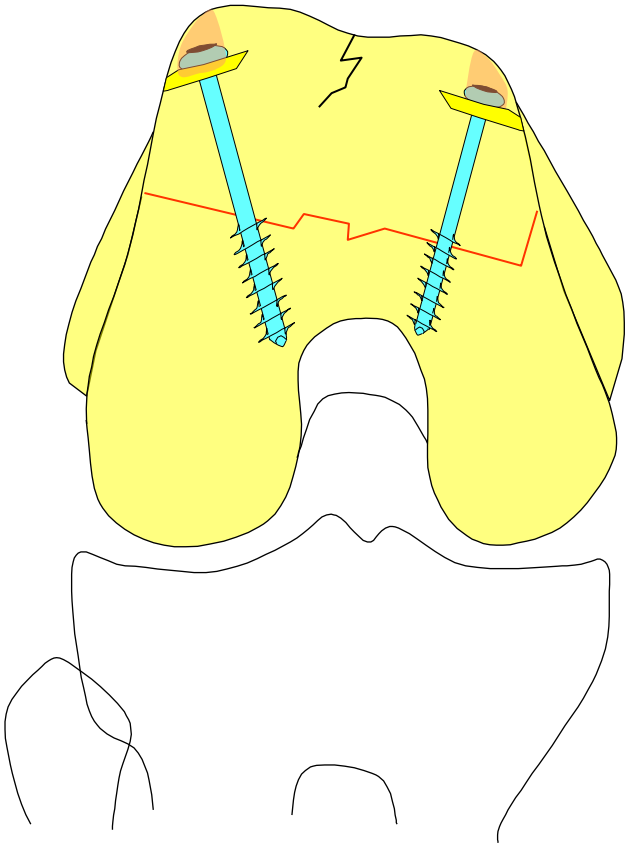


2 Joysticks controlled 3-plane manipulation



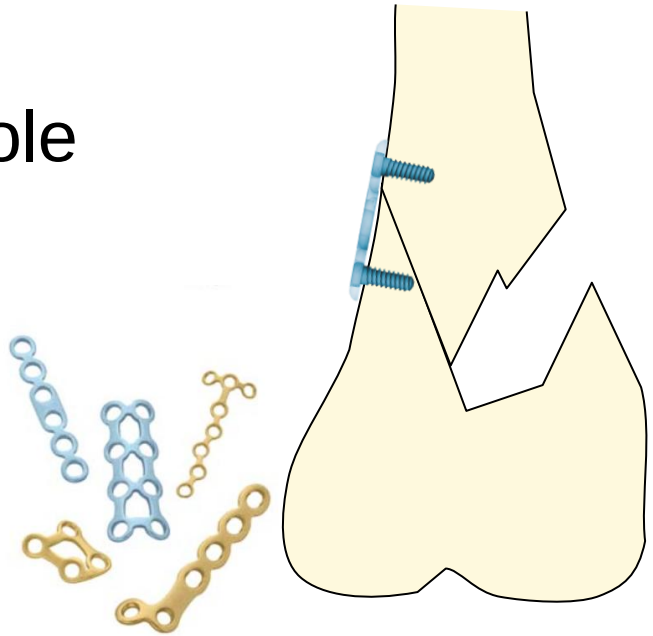
Problem horizontal fx lines





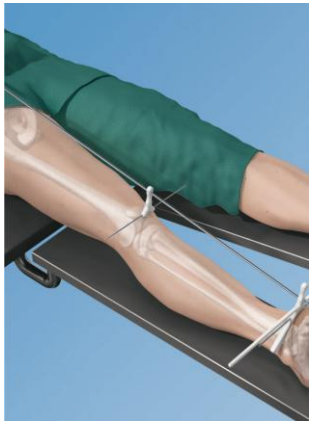
provisional fixation articular block to shaft

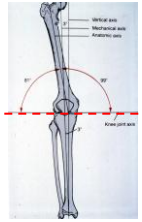
- K-wires
- distally fixed plate
- small plates (1/3 tubular, 2-hole mini plates from hand set)
  - anti-glide function
  - good temporary stability
  - still some flexibility (torsion, varus/valgus)
  - minimal periosteal damage



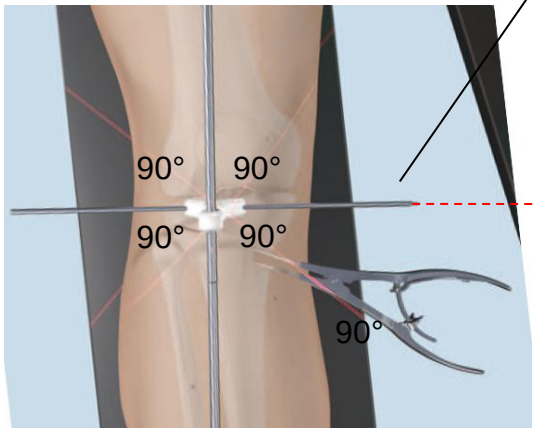
provisional fixation articular block to shaft

Alignment rod +++ helpful in floating knee situations

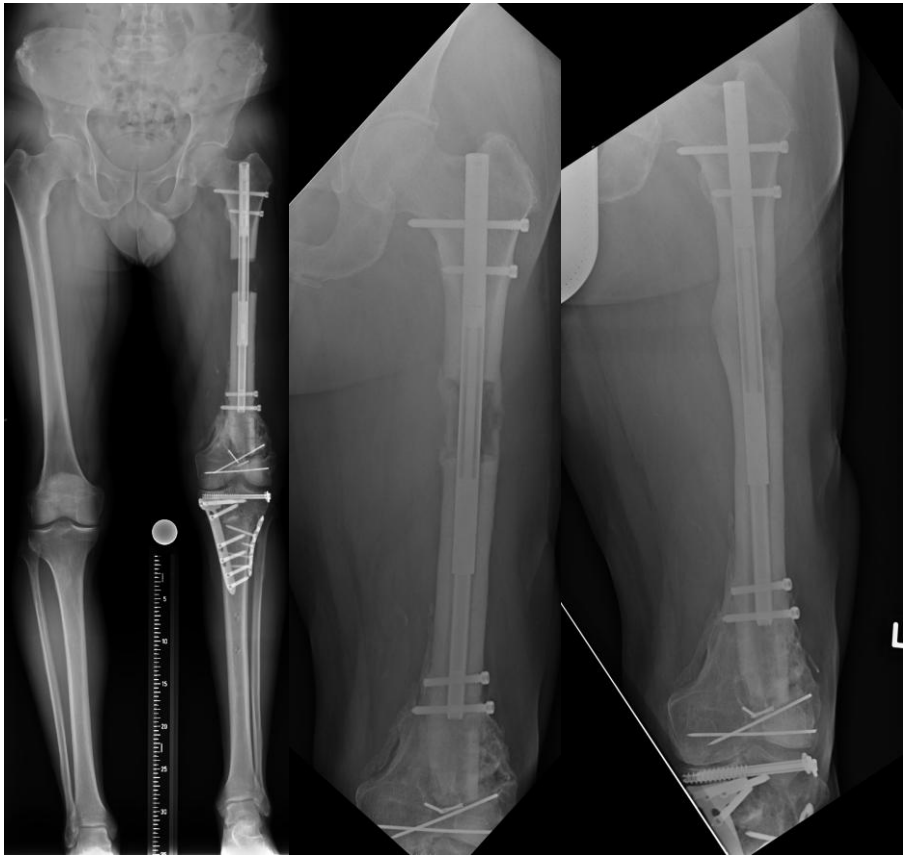




90° reference clip



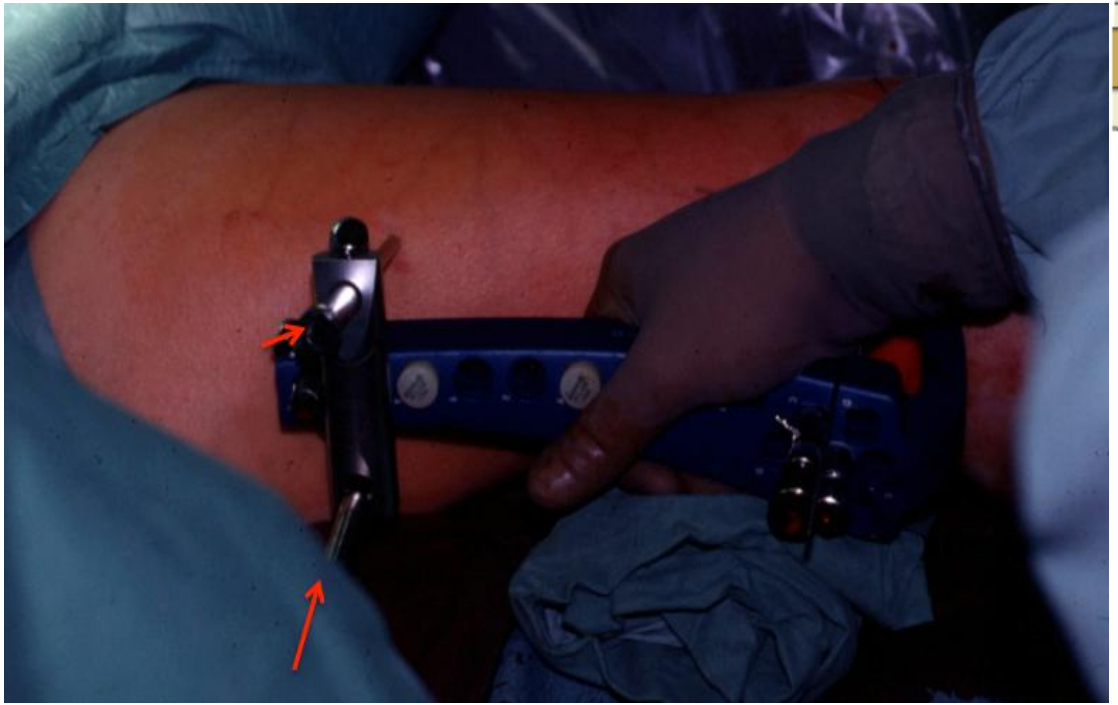
Secondary lengthening after distal fx healing



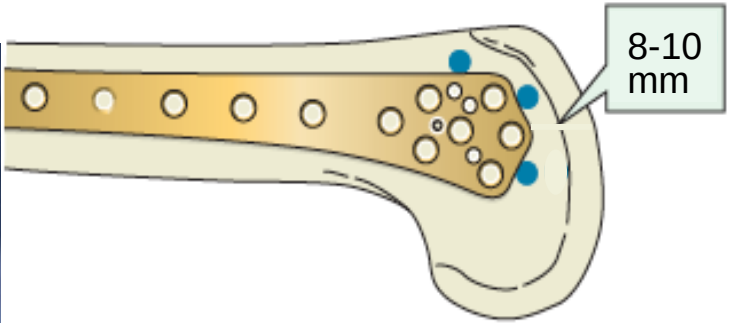
FU 4y
VAS 3
SF 36 phys health 40 (45)
WOMAC 24/100 (best 0)
Lysholm 65/100 (best 100)

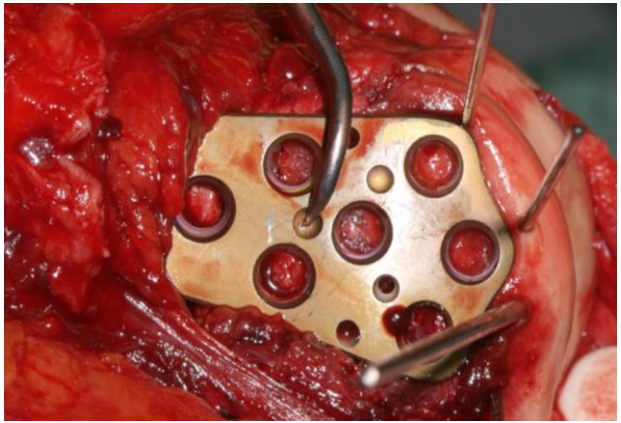
Plate placement: Fencing

proximal K-wire fence



distal K-wire fence

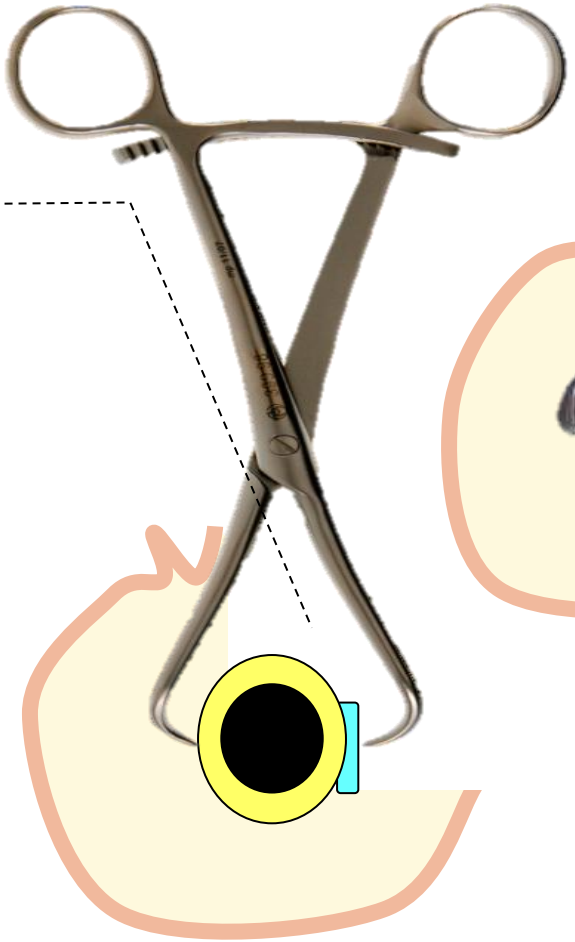




temporary plate fixation

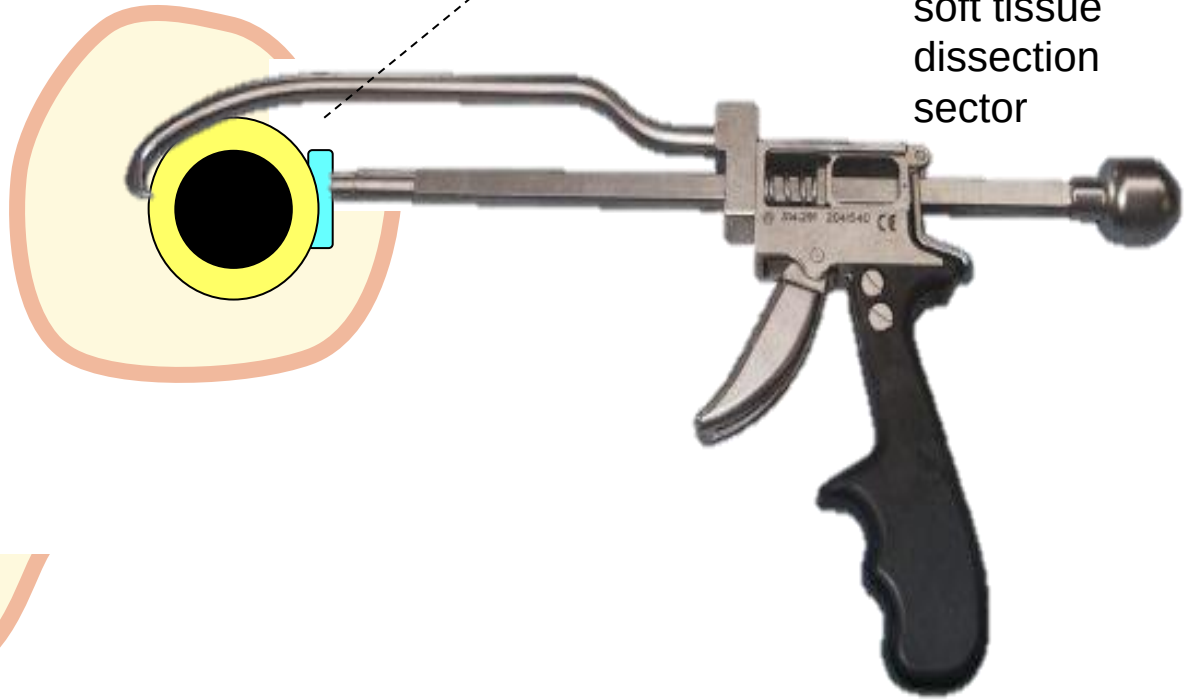
traditional
bone clamp:

large (90°)
soft tissue
dissection
sector

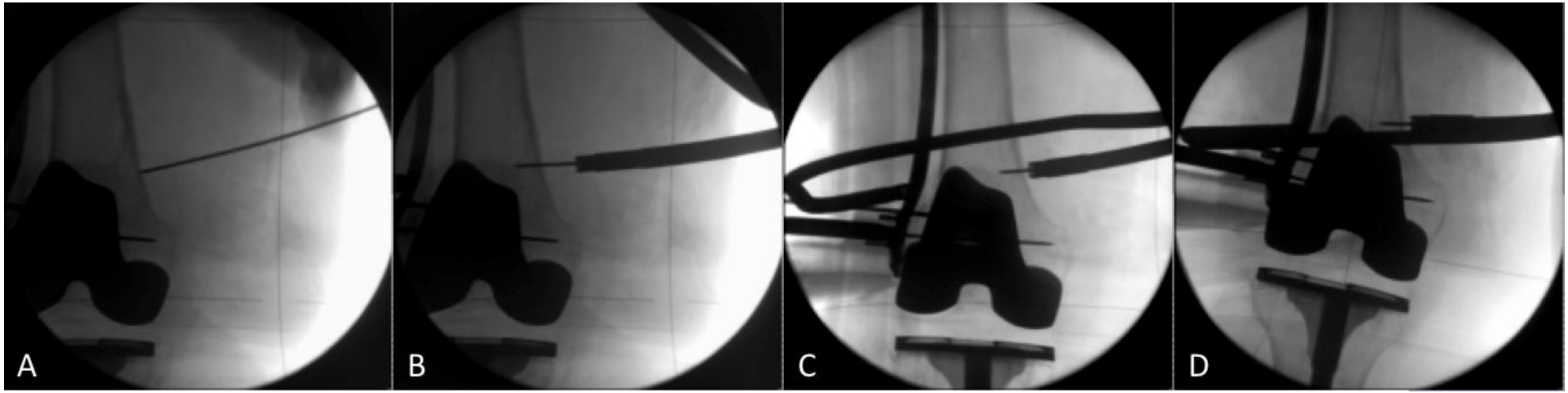


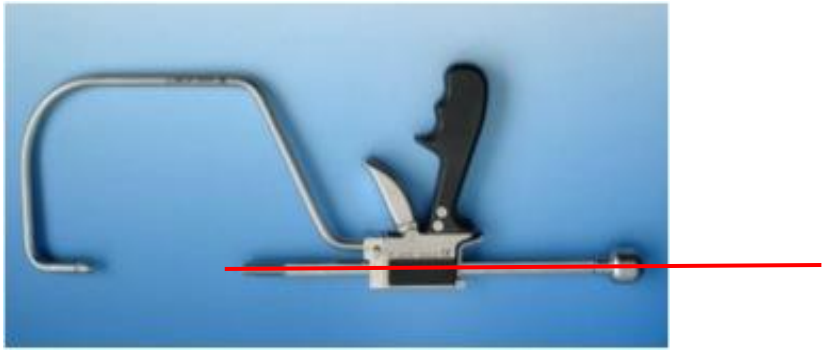
colinear
bone clamp:

small (30°)
soft tissue
dissection
sector



Problem temporary plate fixation: avoid slipp off with K-wire in colinear clamp

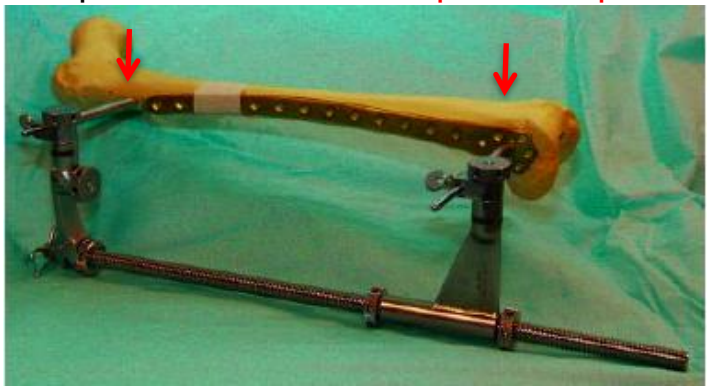




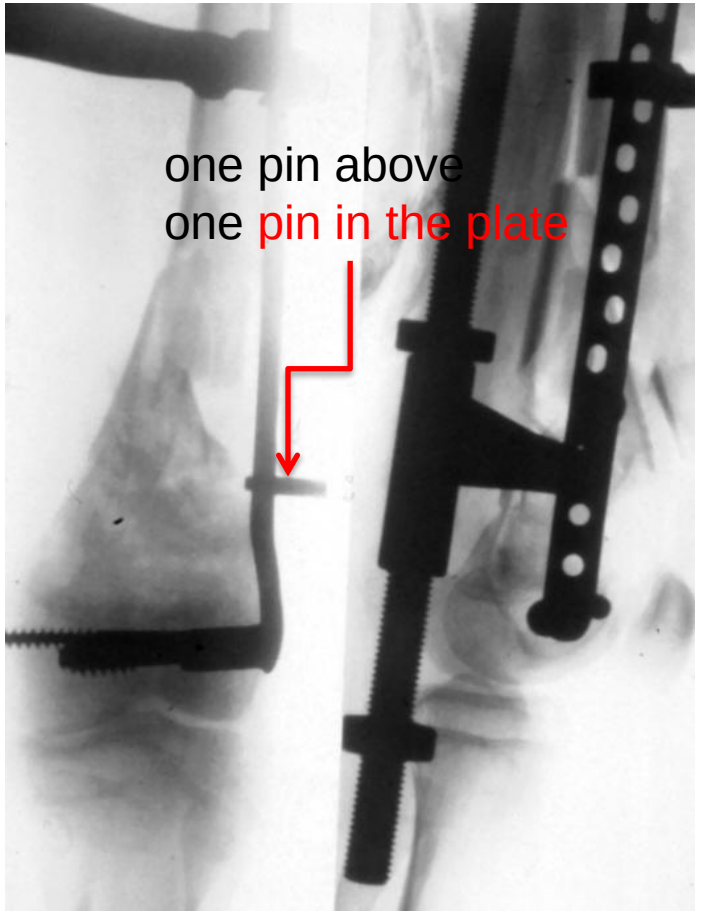
Large Distractor: pin options

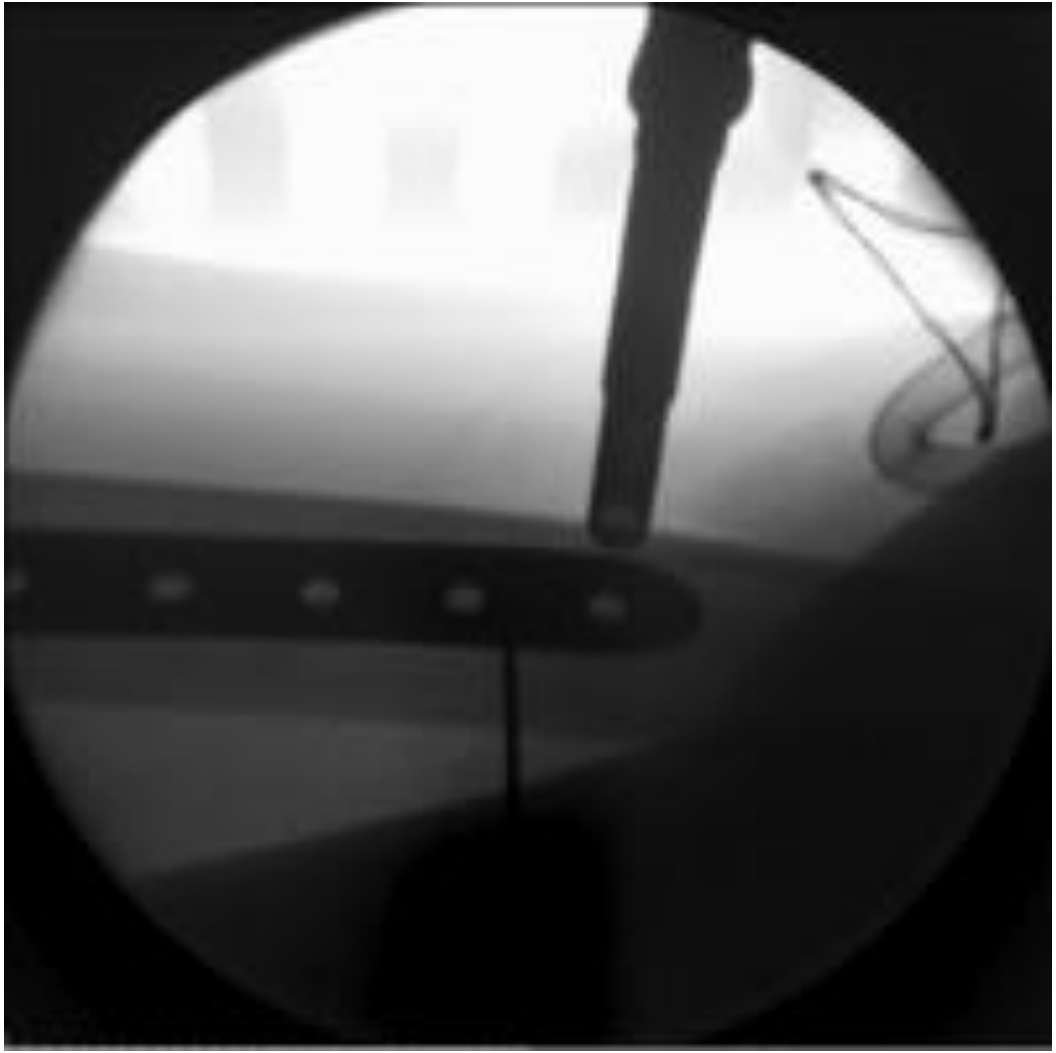
Distal: in proximal tibia
excludes knee motion and
limits access to distal femur.
... distal pin placement in plate:
control length, still play with
rotation and frontal/sagittal plane

one pin above ... one pin in the plate



Babst R. et al. Unfallchirurg 2001 104(6):530-535





Question:
is the plate centered properly ?

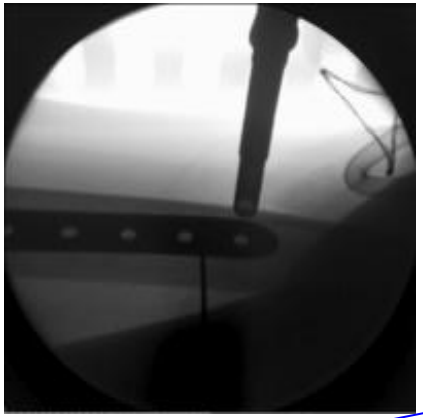
Don‘t get fooled by projection errors

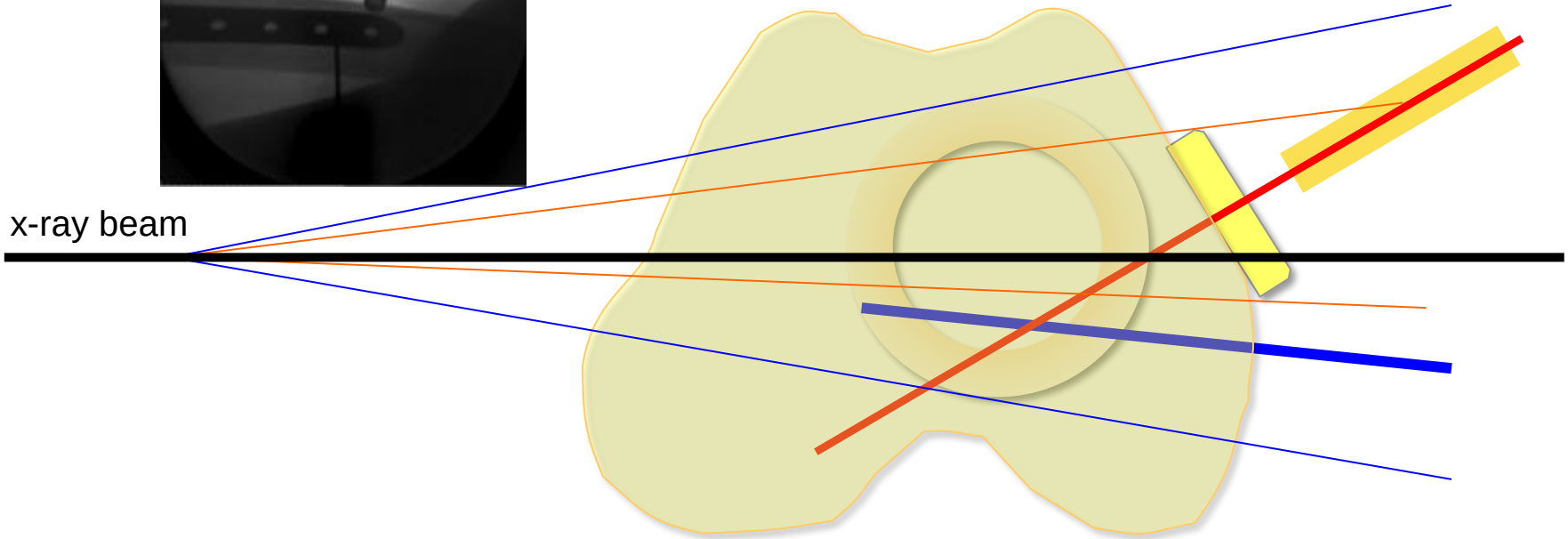
xray beam vector is not vertikal to plate vector

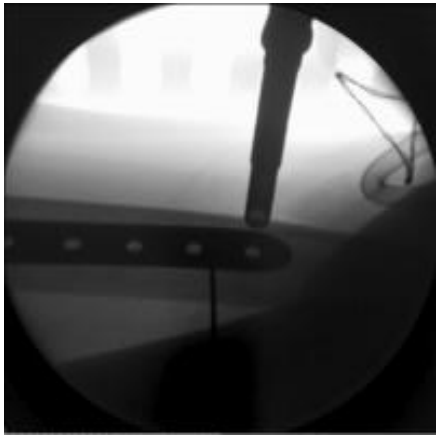
technical details

1) anti-slip off K-wire fencing

2) be aware of projection errors



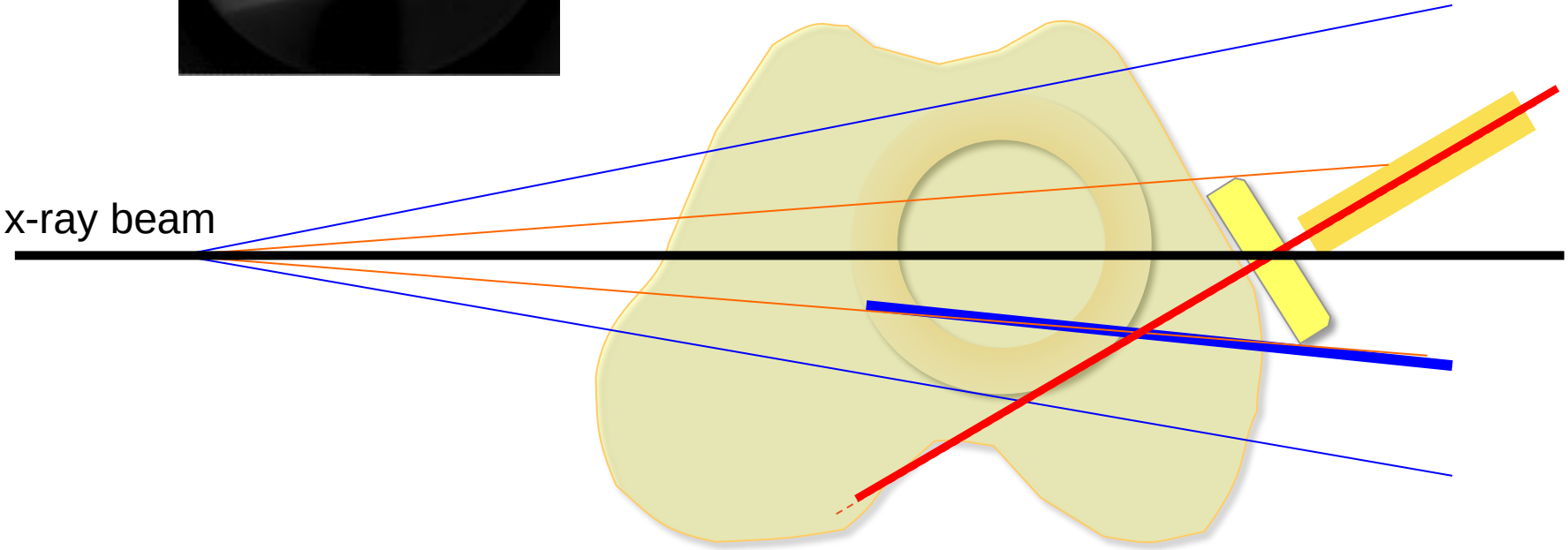




technical details

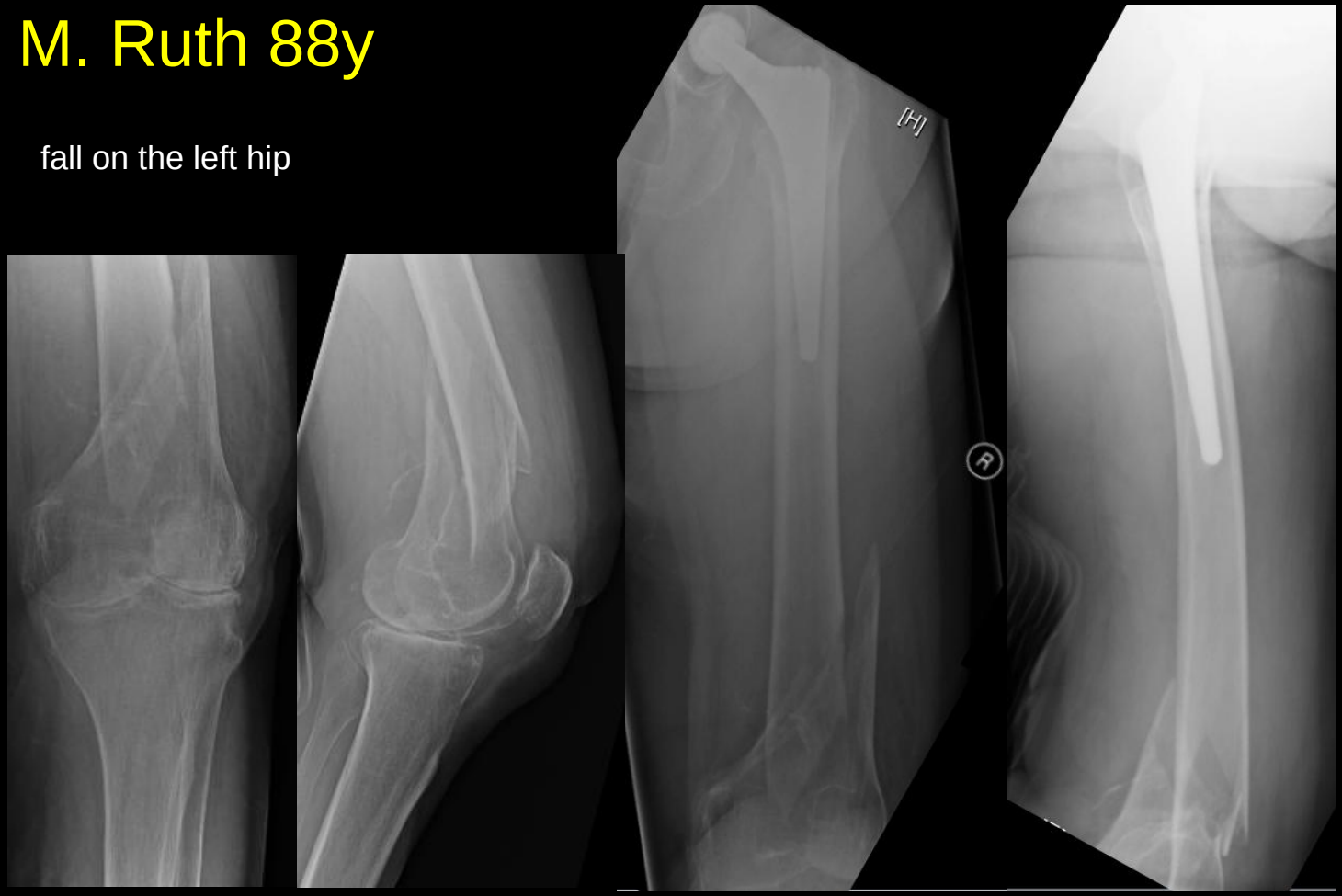
1) fencing anti-slip
off K-wire

2) be aware of
projection errors



M. Ruth 88y

fall on the left hip



Ruth M. 86y

1 week postop surgery

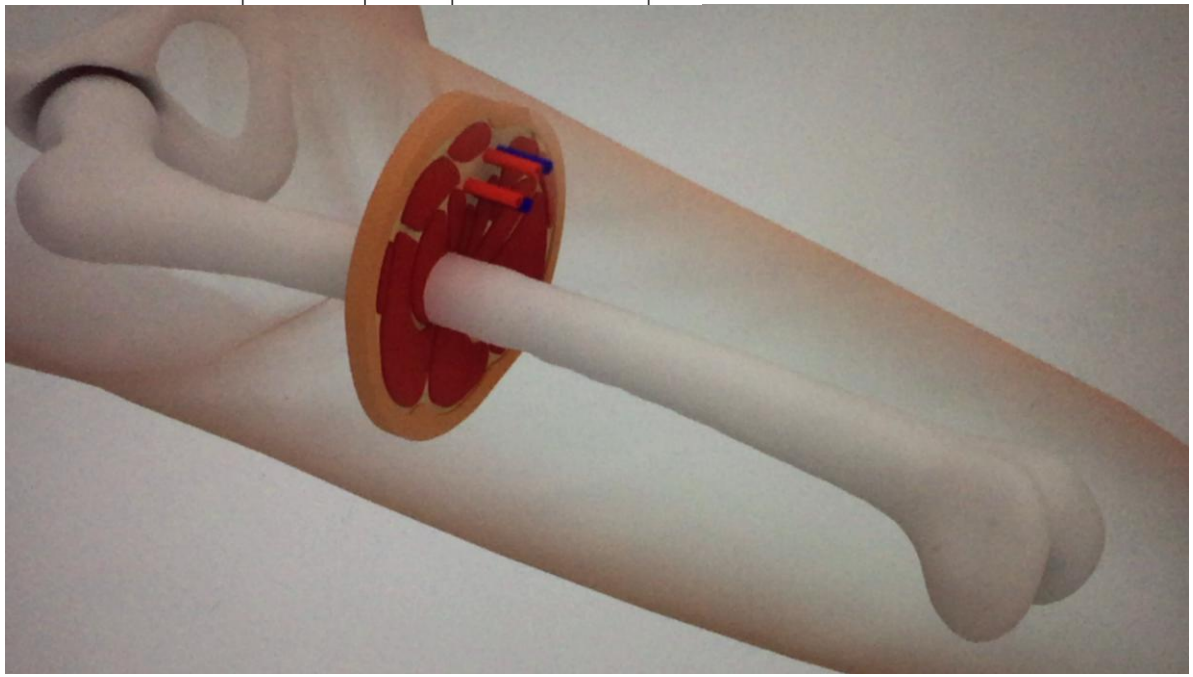
Ruth M. 86y after revision (longer plate, additional cerclage wires)

	shear reststance	pullout resistance
cerclage	-	+++

Ruth M. 86y after revision (longer plate, additional cerclage wires)

	shear reststance	pullout resistance
cerclage	-	+++
screw	+++	-
combination	+++	+++

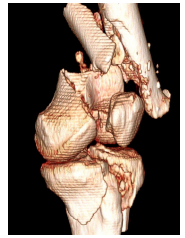
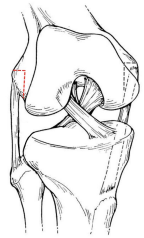
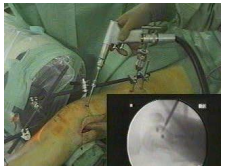
2 component cerclage wire passer

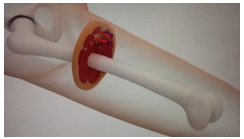


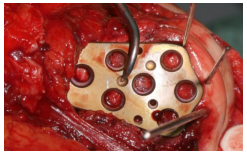
ICUC

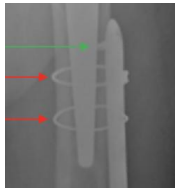
Summary Fragment Specific Fixation

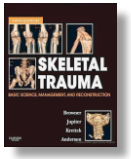
- Preop alignment analysis contralateral side ... workshop (length, rotation, hyperextension)
- Approaches different for extra- & intraarticular fx
  option: epicondyle osteotomy
- Reduction tools (distrator, joystick, spreader, Lisstractor, colinear clamp, cerclage wire passer)
- Fixation concept: make A-type …a C-type
  Miniplates
  Fencing K-wire cage
  Cerclage - locking screw combination



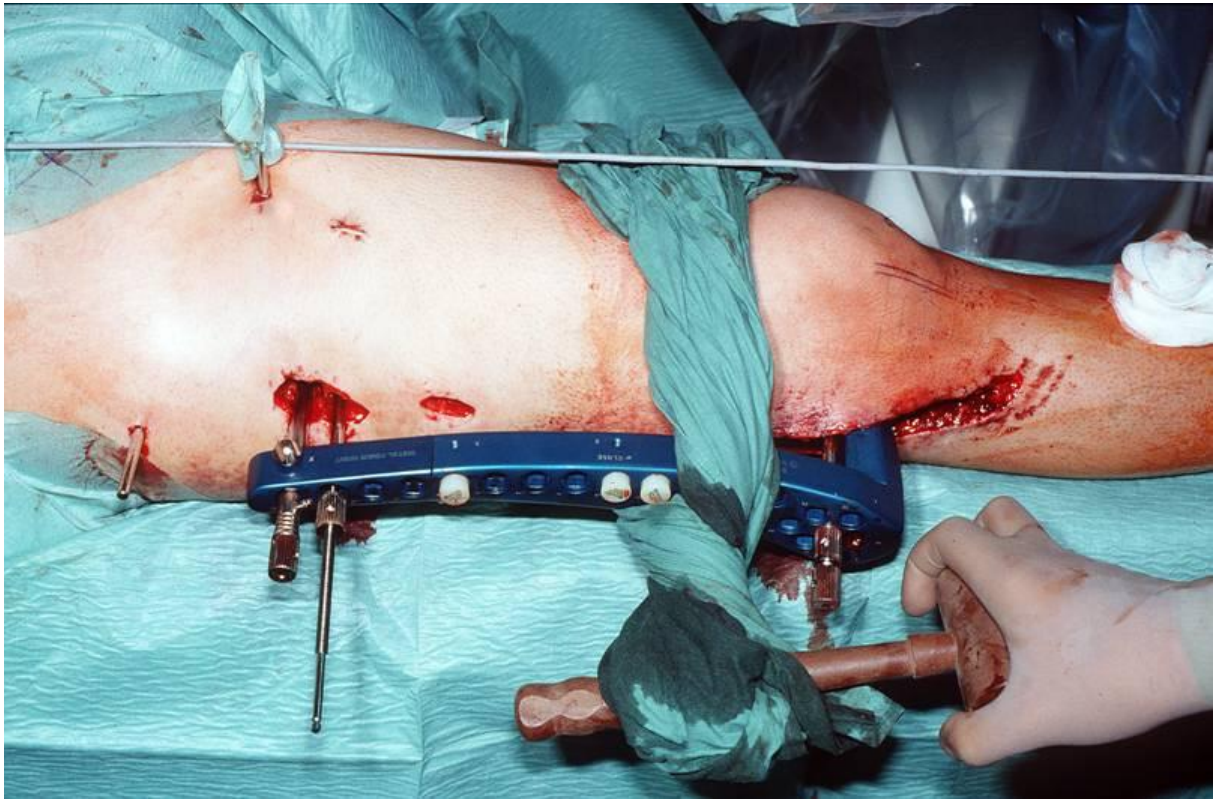




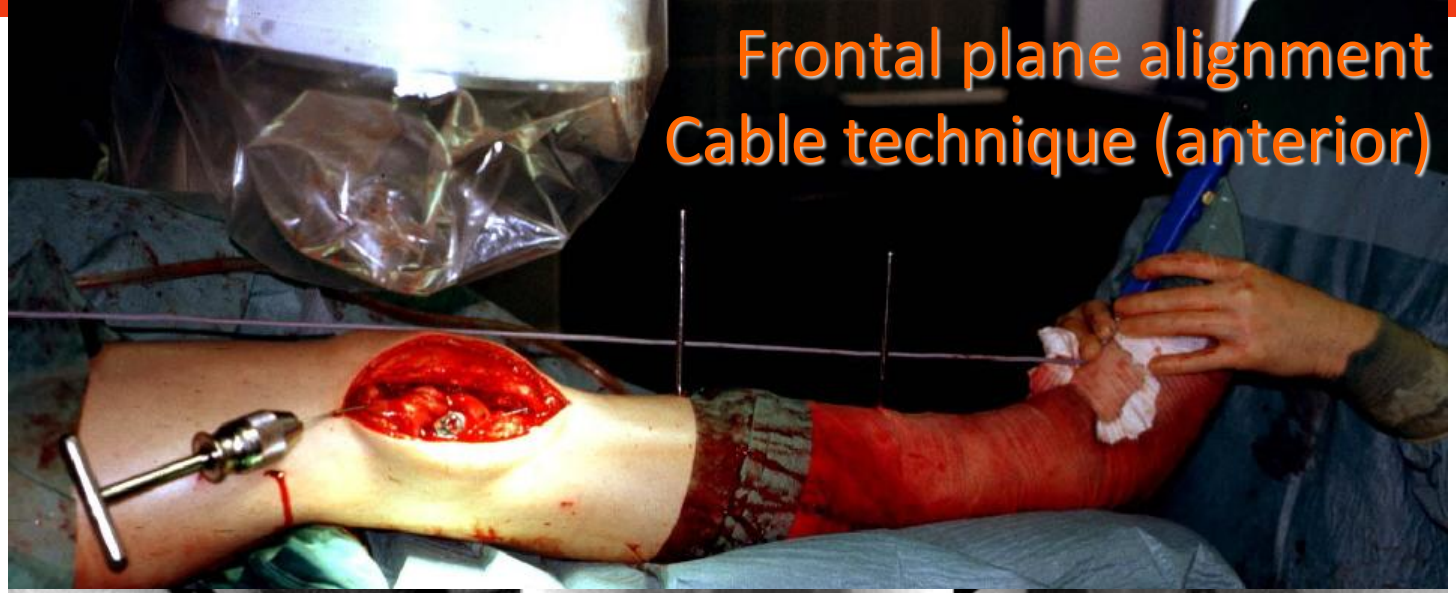


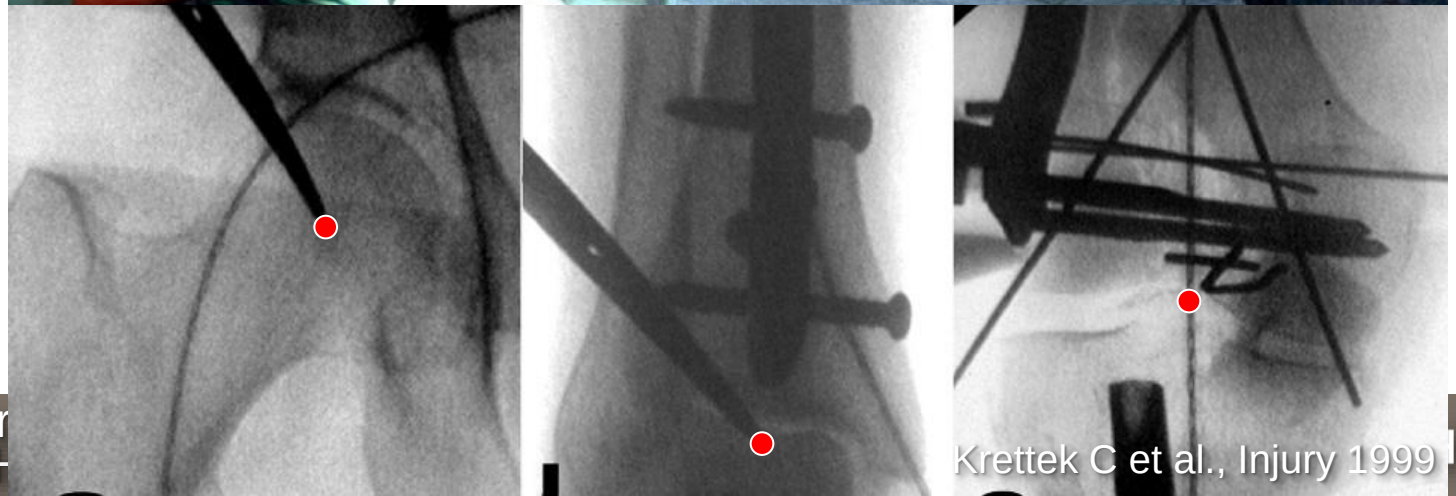
Krettek C Fractures of the Distal Femur.
In: Skeletal Trauma.
Editors Browner BD, Jupiter JB, Krettek C, Anderson P
5th ed: Saunders Elsevier; 2015

Reduction Tricks: Towel



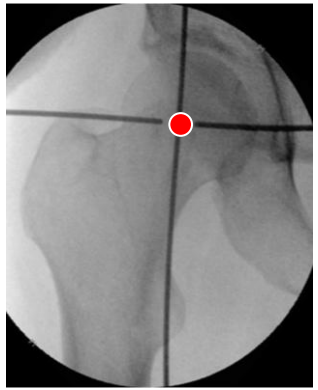
Frontal plane alignment
Cable technique (anterior)

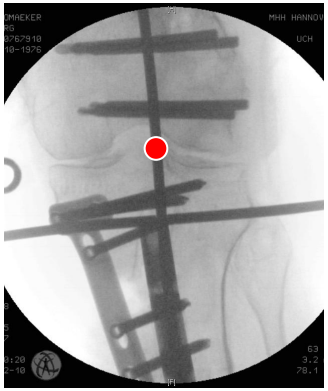




Krettek C et al., Injury 1999

Frontal plane alignment Alignment Grid (posterior)





underneath patient
underneath padding

- good precision (close to navigation)
- cheap
- flexible

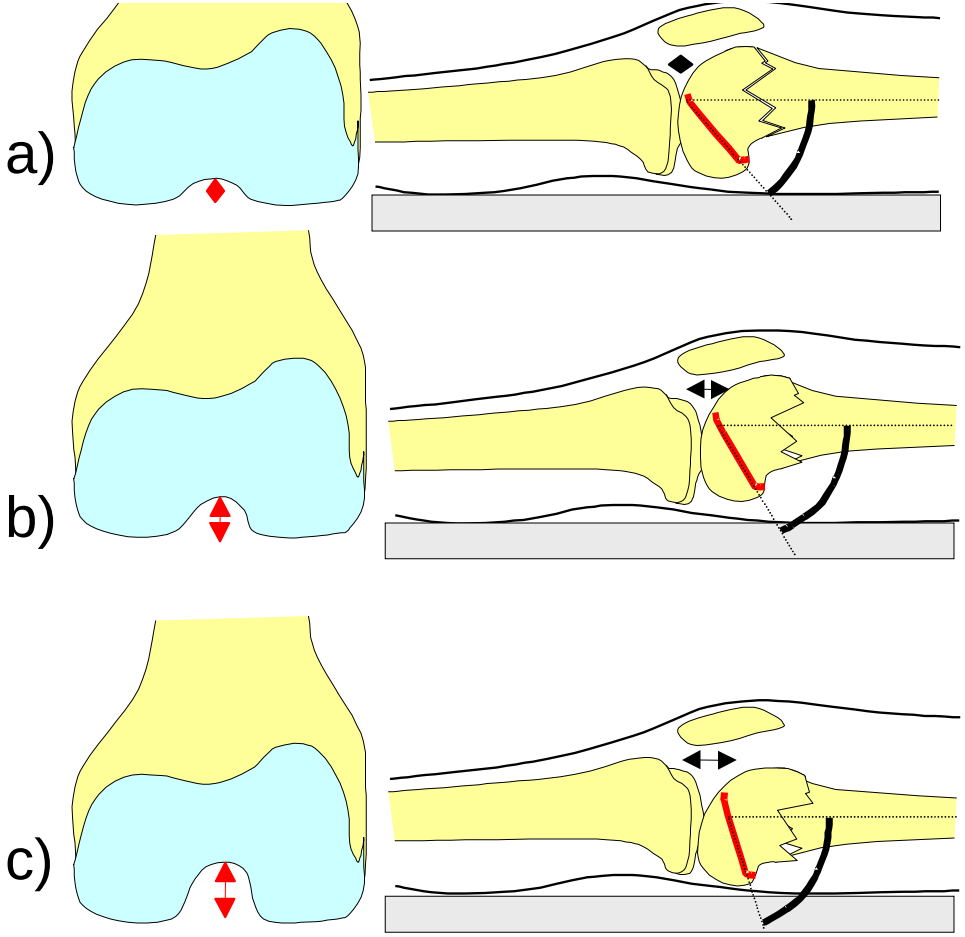
disadvantage

- radiation exposure
- only 2D

Liodakis E, Tech Health Care 2010
Krettek C, Injury 1999

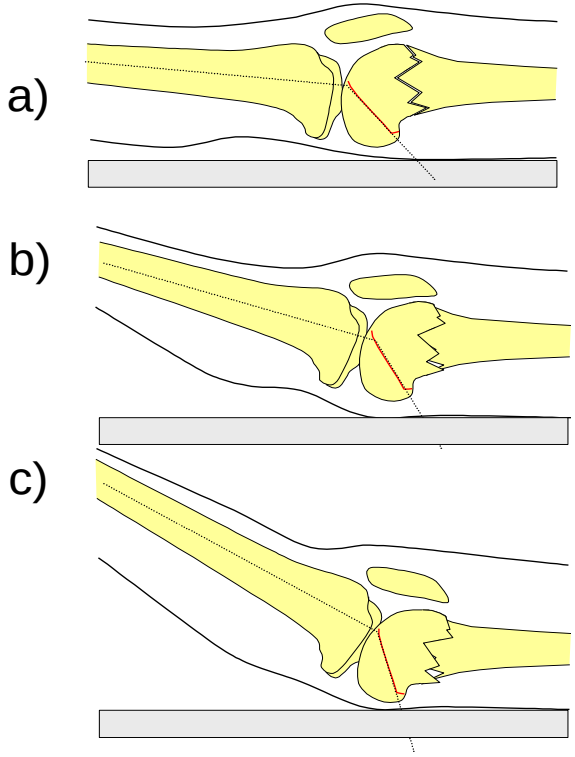
genu recurvatum: notch sign

positive notch sign
if you see a notch like this, the distal main fragment is in overextended position



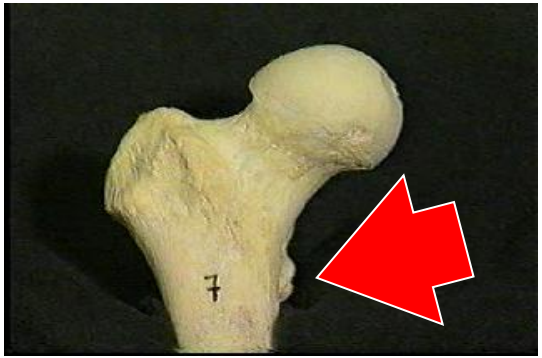
genu recurvatum: hyperextension test

... Full extension necessary for ante-recurvatum check



‚Hyperextensions Test‘

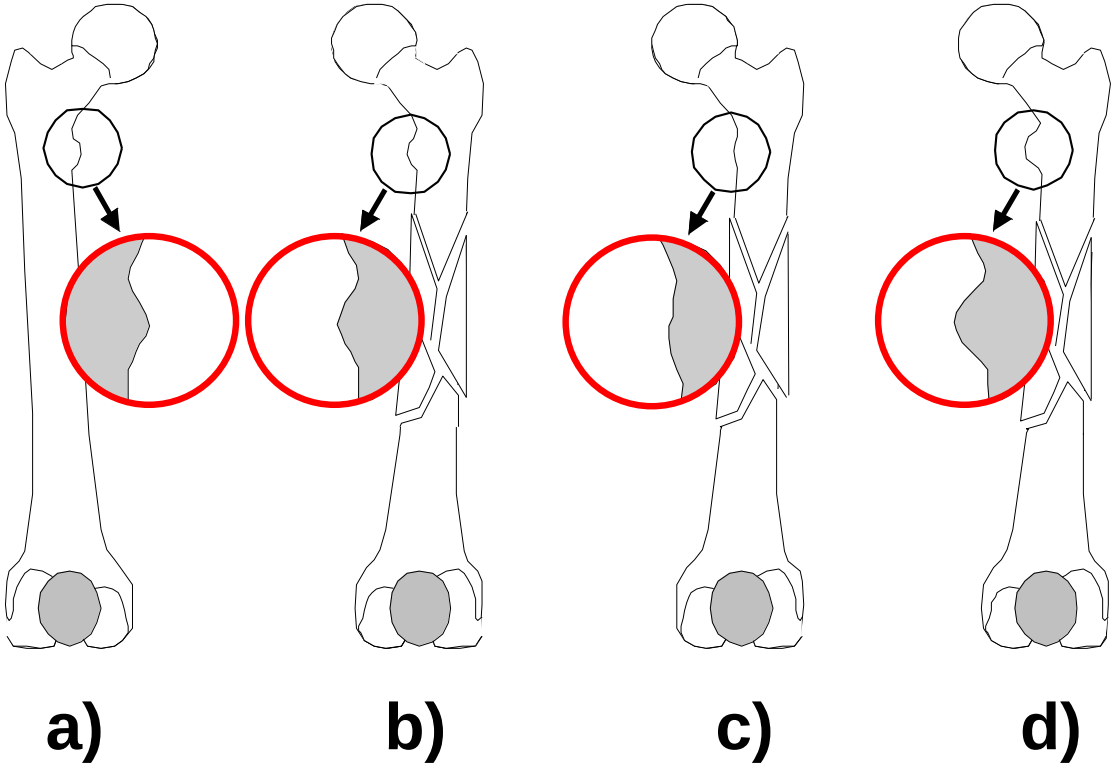
How Can we Control Torsion?
Lesser trochanter shape sign



comparison contra-lateral

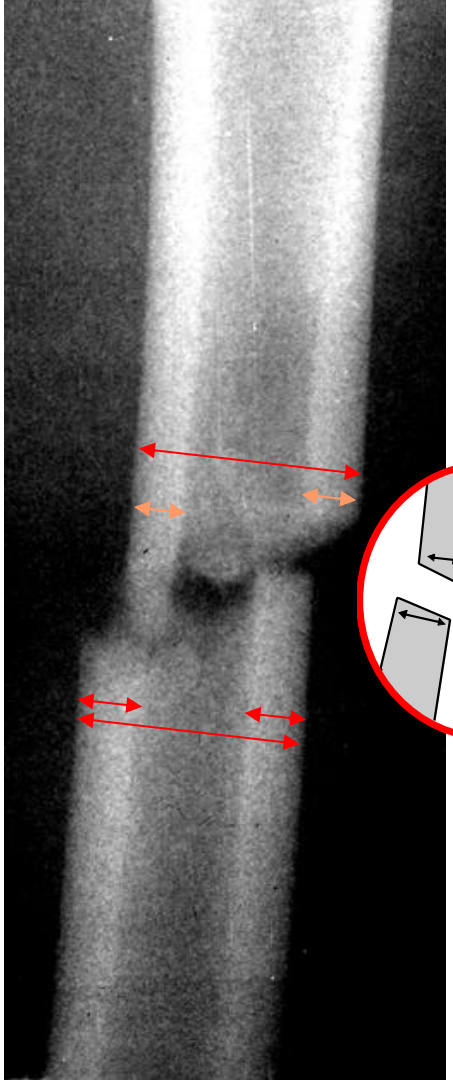
Krettek et al (1999) Injury 29, Sup 3

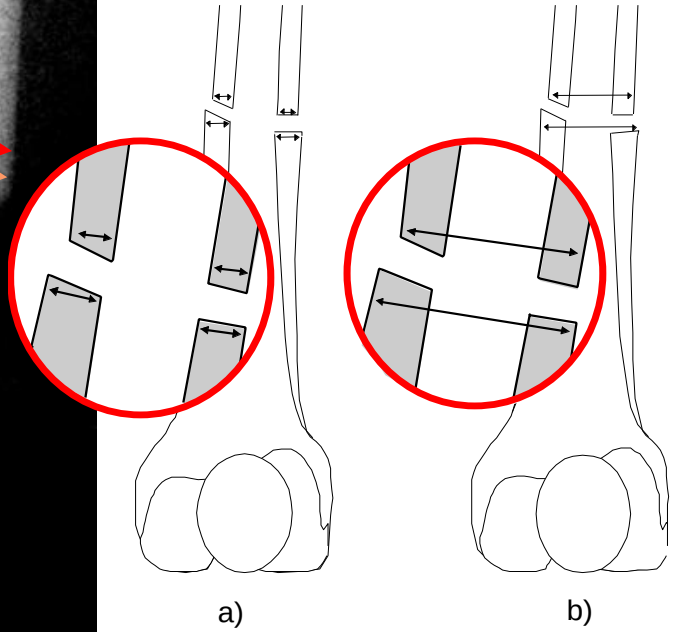
Lesser trochanter shape sign



Kim JJ, Kim E, Kim KY (2001) Predicting the rotationally neutral state of the femur by comparing the shape of the contralateral lesser trochanter. Ortho-pedics 24: 1069

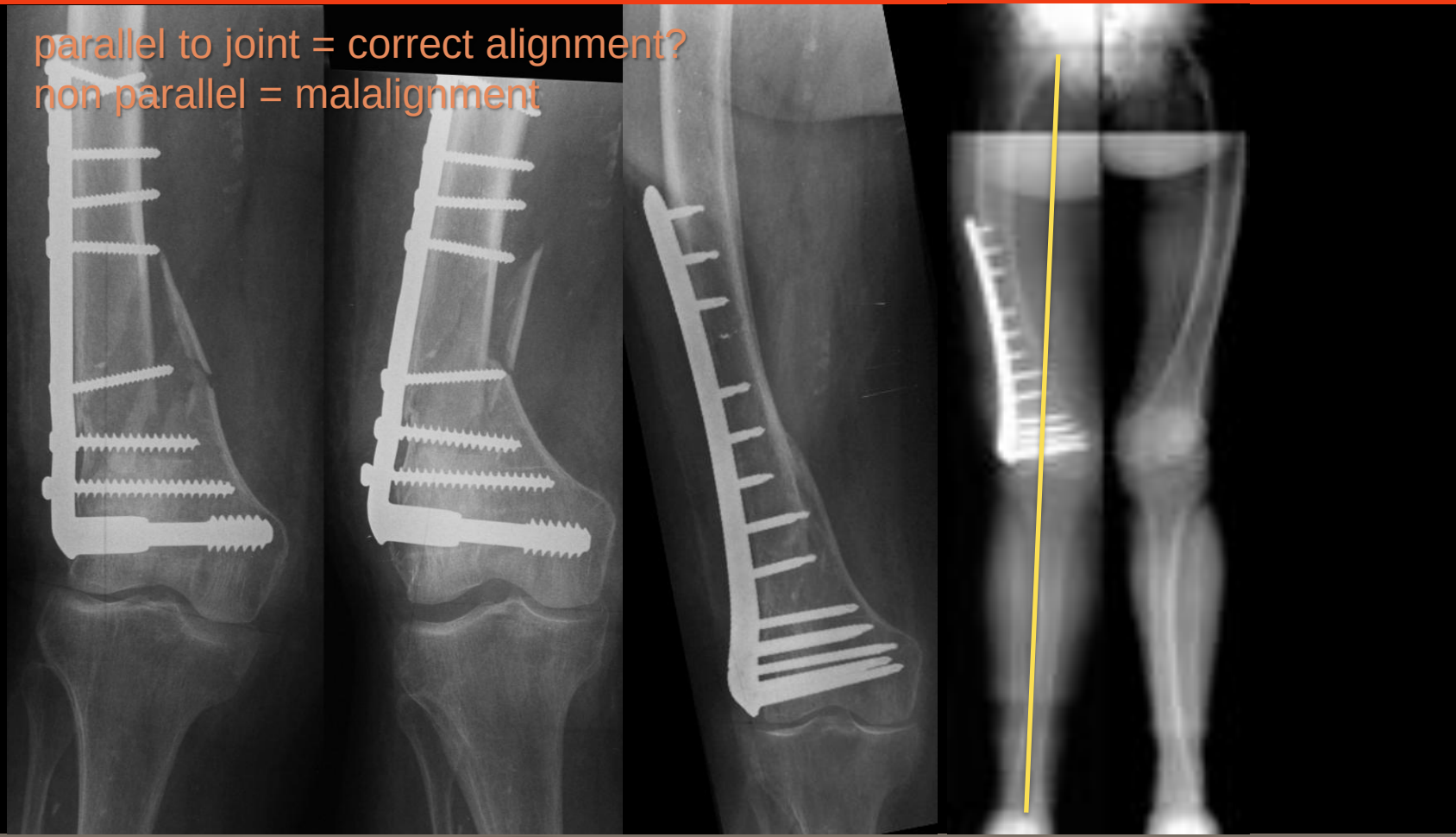
Cortical step sign & Diameter difference sign





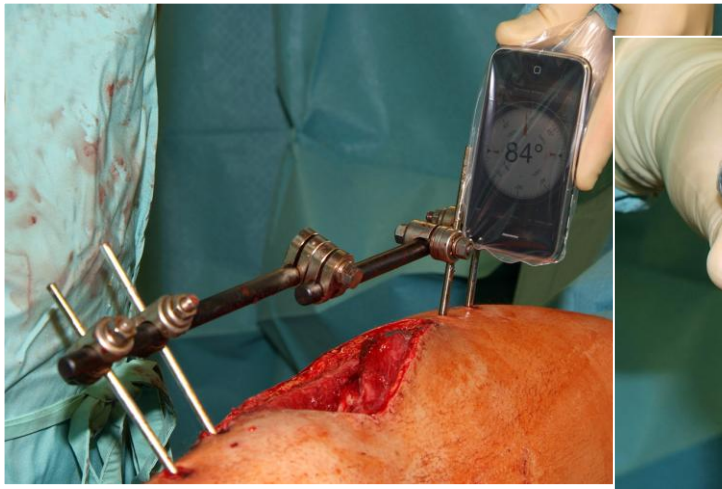
Krettek et al (1999) Techniques in Orthopaedics 14:247

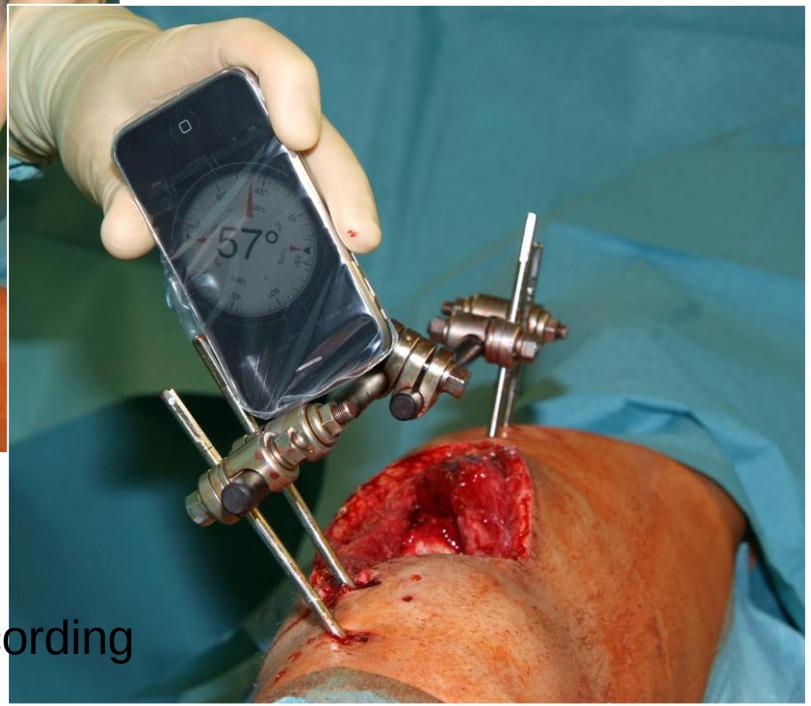
parallel to joint = correct alignment?
non parallel = malalignment


parallel to joint = correct alignment?
non parallel = malalignment

iPhone supported Torsional Correction

MHH ethic committee approved, clinical study 2010/2011)





prox: 84°
distal: 57°
correction & calculation according CT scan data

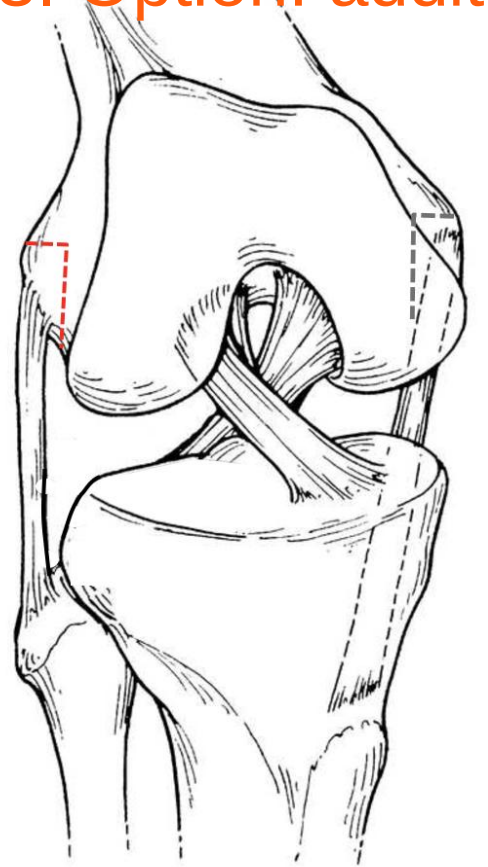
Warning: off label use!!!

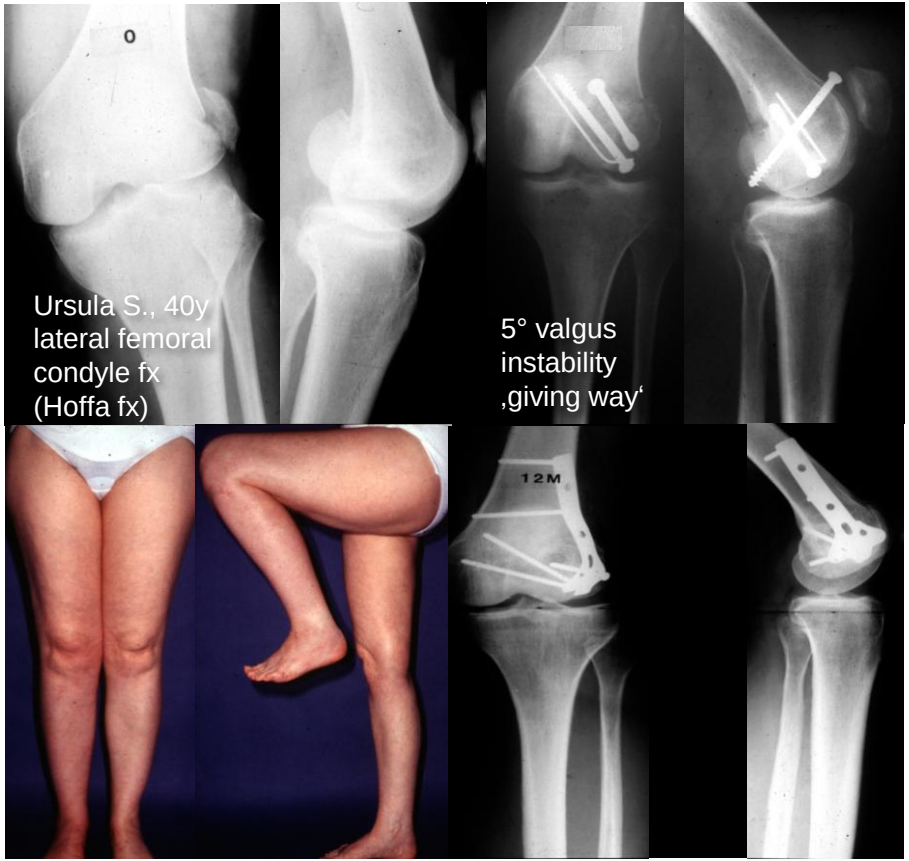
Summary Obtaining/Maintaining Reduction

- preop analysis contralateral side
  (length, rotation, hyperextension)
- positioning / approach planning
- reduction tools (distrator, joystick, spreader, Lisstractor,
  colinear clamp)
- alignment control
  cable technique, lesser troch, hyperextension test

reduction aids

3. Option: additional epicondyle OT (B1-3)



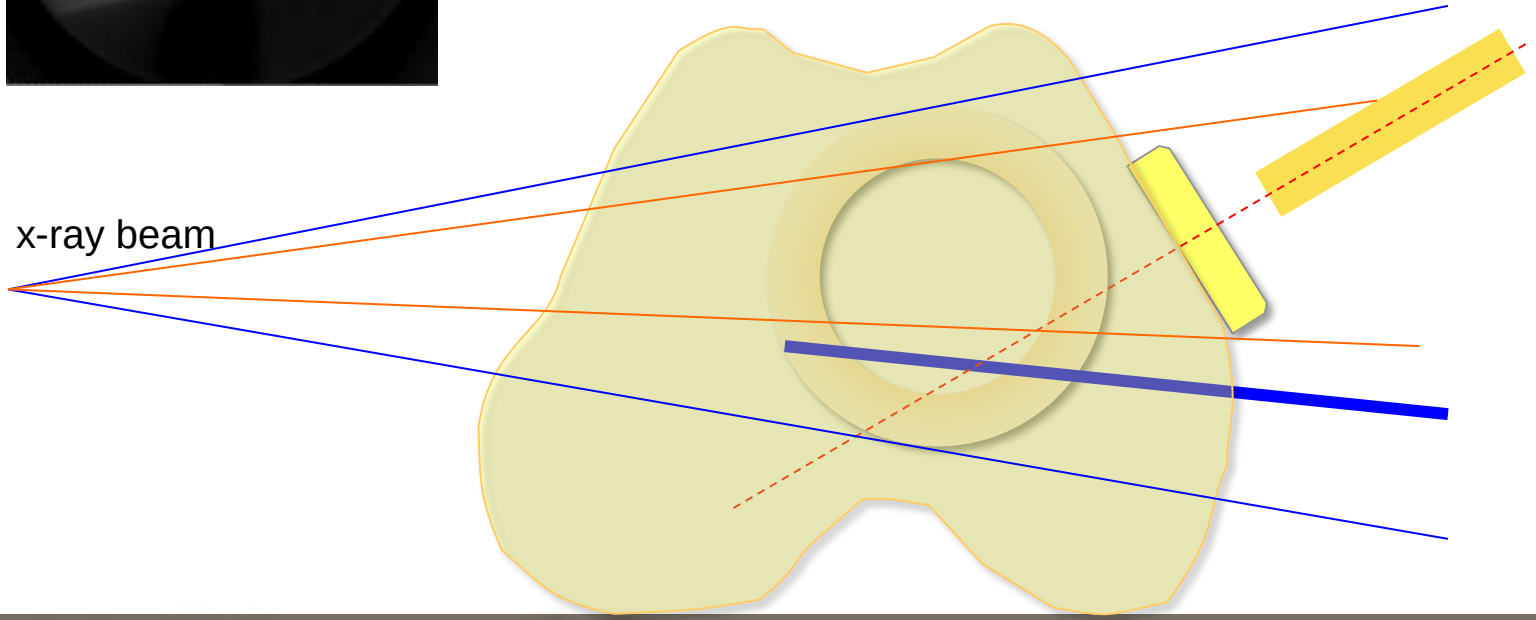


Question:
is the plate
centered properly
?

technical details

1) anti-slip off K-wire

2) be aware of projection errors



technical details

1) anti-slip off K-wire

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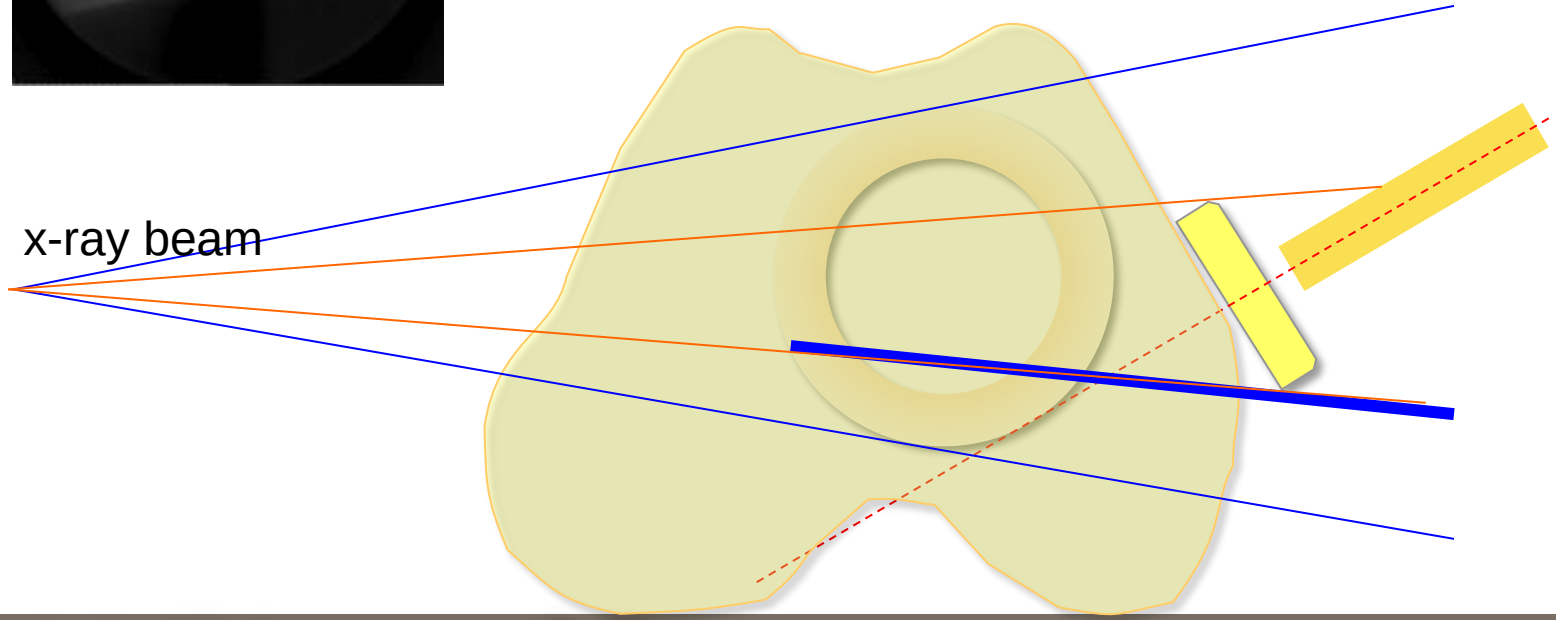

Floating knee

65 y, massively destructed, infected