

San Francisco Trauma Course 2024

Short Segment Tibial Fractures How to Ensure Reduction

Christian Krettek, Hannover Germany

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No conflict of interest

Objectives

- Understand problems related to nailing of proximal tibia fxs
- discuss the specific anatomy
- realize the dislocating risk factors
- understand the role of starting point
- Learn about various options how to ensure reduction

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Problems

instability / malalignment

Proximal

- Tornetta, CORR 1996
- Henley, JOT 1993
- Ahlers, UCH 1992
- Freedman & Johnson, CORR 1995 up to 58% > 5°

Midshaft

Freedman CORR 1995
7% > 5°

Distal

Freedman & Johnson CORR 1995
8% > 5°
Robinson JBJS-B 1995
6% malalignment

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#1 Understand the Fracture Mechanics & fx Pattern

- Why is understanding of fracture mechanics important?
- Fracture orientation proximal fragment?
- Lateral up – transverse – medial up?
- Implications for deformity?
- Risk for malalignment?

Oblique & wedge fx: higher risk for deformity compared to transverse fx

Lateral up – transverse – medial up?

more toggle less toggle

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#2 Understand Excentric Muscle Distribution

all muscle on the lateral side / posterior valgus / antecurvature deformity

- Tibialis anterior
- Fibularis longus
- Extensor digitorum longus
- Fibularis brevis
- Extensor hallucis longus
- Fibularis tertius
- Superior extensor retinaculum
- Inferior extensor retinaculum

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#3 Understand Tibia Excentricity and it's implication for Starting point

Tibia excentric bone

Study: retrogradely reamed tibias exit point analysis relative to tibial tubercle

0% 25% 75%

50% medial 50% lateral

Too medial: higher risk for deformity compared to more lateral starting point

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#4 Understand Tibio-Patellar Topography & its implication for ...

- skin incision & bone starting point
- nail canal
- alignment
- stability

Starting Point lateral view starting point: Oedge starting direction: stay steep

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#5 Understand Excentric Bone Distribution

anterior high density
posterior low density

Starting Point lateral view starting point: Oedge starting direction: stay steep

correction posterior to anterior difficult
correction anterior to posterior easy

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#5 Understand Excentricity of Shaft Cross Section

skin incision

frame assisted tibia nailing no fracture table

skin incision & starting point in line with medullary cavity

this is what you feel anterior tibial crest
this is what you need center of medullary canal

General Rule in IM Nailing
Skin incision ... defines starting point ... starting point defines alignment

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Approach

ability for painfree kneeling depends from

- incision length (p=0.007, n=5.139)
- position of nailtip (p=0.013, n=4.463)

n=131, FU 12-36 months / Anova (1), Kruskal Wallis, Schandensimer 1999

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Approach

options ...

- suprapatellar
- parapatellar
- trans Ligamentous
-
- more data needed ...

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Instruments

Distractor / temp exfix
Co-linear bone clamp
Schanz-Screws
T-handle

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Instruments
Ex-Fix Frame

Clothesline technique

"Clothesline technique" for proximal tibial shaft fracture fixation using conventional intramedullary nail:
William Das, Belangero et al. European Journal of Orthopaedic Surgery & Traumatology (2018)

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Additional implants
nail + Plate

sharing of tasks

plate: translation rotation
nail: length bending

Nork SE, Barei DP, Schildhauer TA, Agel J, Holt SK, Schrick JL, Sangeorzan BJ (2006) Intramedullary nailing of proximal quarter tibial fractures. J Orthop Trauma 20(8):523-528

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Additional Implants
Poller Screws

Krettek et al (1999) JBIS-B
Krettek et al (1999) J Orthop Trauma

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Additional Implants Surgical Technique
Poller Screws

temporary nail removal
Poller screw in old nail path orientation ap C-arm control
nail insertion
distal locking + backslap

1. 2. 3. 4.

Krettek et al (1999) JBIS-B
Krettek et al (1999) J Orthop Trauma

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Additional Implants
Poller Screws

IRW

Krettek et al (1999) JBIS-B
Krettek et al (1999) J Orthop Trauma

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3 Problems in metaphyseal tibia fx's with im nailing

1. diameter discrepancy nail - medullary cavity
2. nail translation along interlocking screws
3. Toggeling due to manufacturing tolerances

5°

plexi-glass model, 8 mm UTN, 3 distal interlocking screws

Krettek et al (1999) JBIS-B
Krettek et al (1999) J Orthop Trauma

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Biomechanics: axial load

Poller screws ...
 reduce diameter discrepancy
 prevent translation along the screw
 increase contact area
 transform shear into compression

Krettek et al (1999) JBJS-B
 Krettek et al (1999) J Orthop Trauma

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Poller Screws can ...

- correct & maintain alignment*
0% <5° vs 58% >5° (Freedman CORR 1995)
- increase primary stability**
up to 58%
- enhance ‚nail-ability‘

but ...

- additional radiation
- potential nail damage
- requires knowledge of patho-biomechanics

*Krettek et al (1999) JBJS-B
 **Krettek et al (1999) J Orthop Trauma 12 (6) 344

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When & what can we use as ‚Poller‘ devices?

- before / after nail insertion
- temporary / permanent?
- different diameters
- different stiffness
 - Locking bolts
 - Screws
 - K-wires
 - Nails
 - Cement

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Case #1

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Case #1

postop
 14.12.10
 15 days postop
 29.12.10

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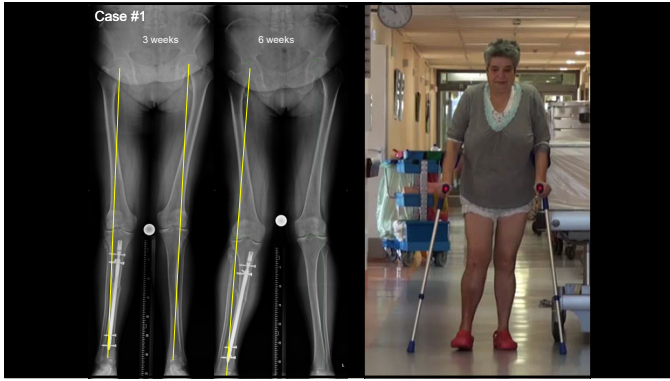
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Case #1

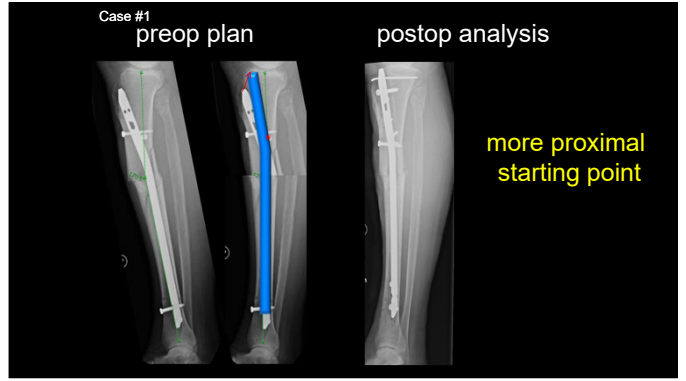
postop
 2 weeks
 3 weeks
 6 weeks

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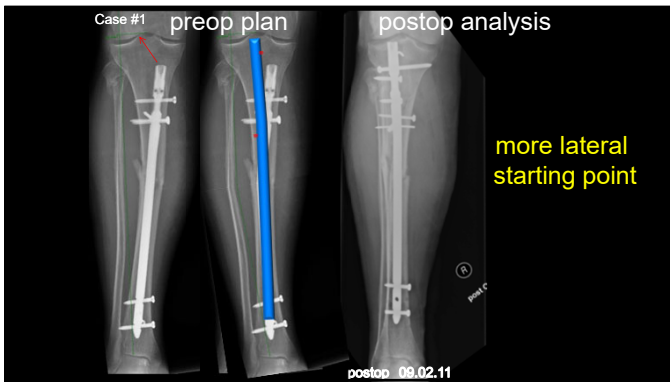
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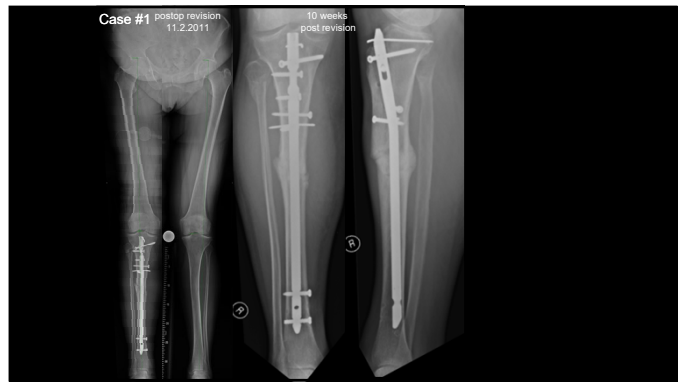
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Summary Nailing of Proximal Tibia Fractures

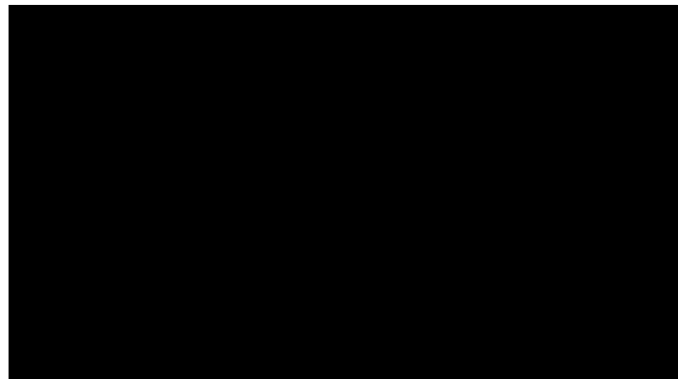
- Positioning / starting point crucial
- Understand Patho-Mechanics
tibia: deformity rules: deforms to the higher fracture line
- Apply to approach & fixation
- Analyze the problems ... early
- Additional tools:
Plate, Exfix, Poller screws, other
- ... its not the implant ...

mostly valgus deformity
• eccentric shape ... start lateral
• eccentric muscle vector
• lateral/proximal to obliquity
• eccentricity of tibial shaft
• eccentricity of tibial crest

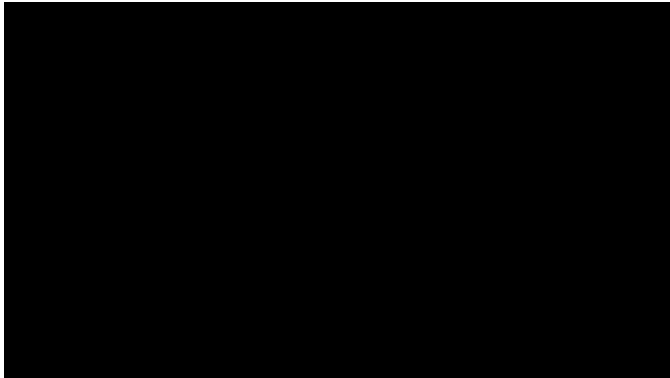
VUMEDI
<https://www.vumedi.com>
YouTube
<https://www.youtube.com>

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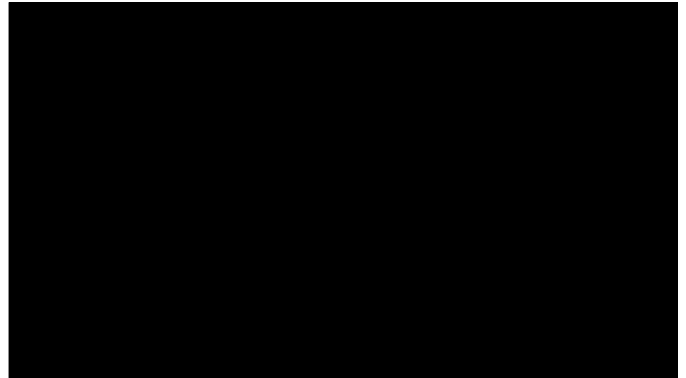
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J Bone Joint Surgery
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Leitendenherausgeber Der Unfallchirurg
Springer

Co-Editor
Skeletal Trauma
(Elsevier)

Medizinischer Leiter OT Update
(med360)

National or international
patients

Objektives

- Understand problems related to nailing of proximal tibia fx
- discuss the specific anatomy
- realize the dislocating risk factors
- realize the role of starting point
- Learn about various tools
- able to master the problems related to im nailing prox Tib Fx



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OTA 37th Annual Meeting

October 20 - 23, 2021 • Fort Worth, Texas

Saturday, October 23, continued

10:15 AM - **Concurrent Breakout Sessions (cont'd)**

11:15 AM **Tips and Tricks for Getting the Metaphysis Right With Different Implants!**

Moderator: Benjamin Ollivers, MD, MA
Faculty: Paul Tarnetta III, MD
Reza Firoozabadi, MD
J. Tracy Watson, MD

Learning Objectives

- Management strategies for complex metadiaphyseal injuries
- Understand different approaches to metadiaphyseal injuries current controversies
- Understand how to optimise outcomes in complex metadiaphyseal injuries

Description

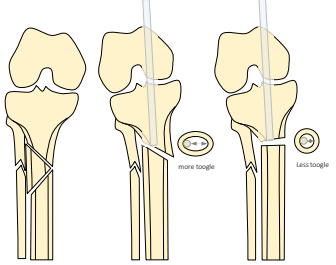
Metaphyseal malalignment is among the most common complication in periarticular injuries. This symposium will cover the technical aspects of contemporary techniques including 'extreme nailing', adjunctive plating, nail-plate constructs and circular frame use. Cases will be used for a discussion of the decision making for complex metaphyseal injuries. Malalignment is common in periarticular injury (5%-25%). These problems can be caused by bad decision making or by technical issues. This session will cover the underlying decision making processes in the key areas of metadiaphyseal trauma to be discussed and understood. The case illustrated discussion session will cover tips and tricks supported by a principles based approach to complex injuries. There have been no similar sessions at the OTA for the past 4 years.

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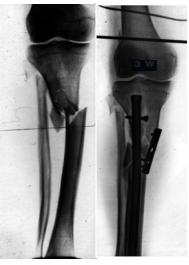
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#1 Understand the Fracture Mechanics & fx Pattern

Oblique & wedge fx: higher risk for deformity compared to transverse fx



Oblique & wedge fx: higher risk for deformity compared to transverse fx



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Do we need intelligent implants ?

... or ... a more intelligent use of existing implants ?

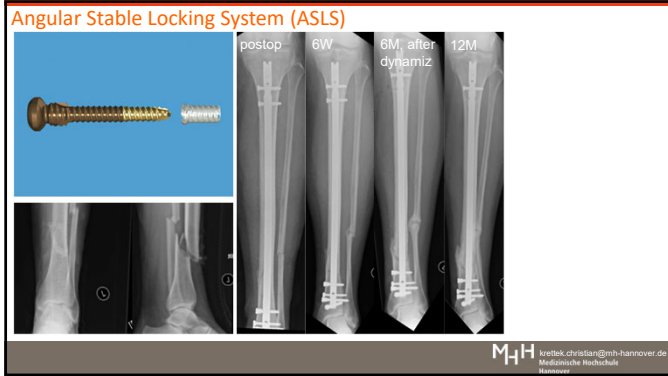


more metal ... more stable ... better outcome ?

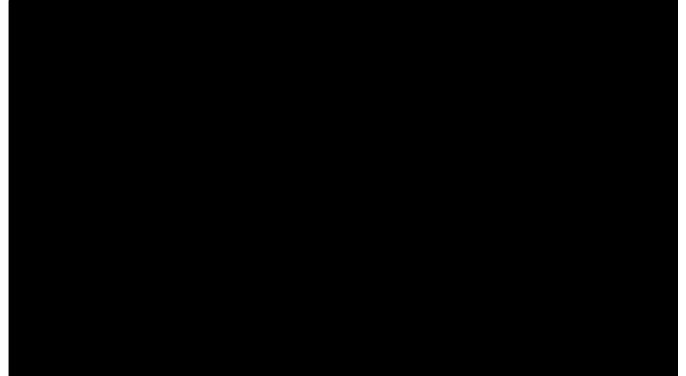


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Summary

1. Overdistraction eases intramedullary nailing
2. Patho-mechanics of IT band and it's role for reduction
3. Double joy stick + C-arm for ,3D'- navigation
4. Through fx retro-grade guide wire placement in obese subtroch fx
5. Implant rotation for small alignment corrections
6. Use of Poller screws for wrong starting point
7. Use of Poller screws for correction of malalignment
8. transosseous cerclage wires
9. role of iPhone in torsional correction
10. Motorized nails for defects /malalignment

VUMEDI <https://www.vumedi.com>

SKELTAL TRAUMA

YouTube <https://www.youtube.com>

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risk factors for valgus

1. excentric bone
2. all muscles lateral
3. bending wedge lack of (lateral) support (most common)

Study: retrogradely reamed tibiae exit point analysis relativ to tibial tubercle

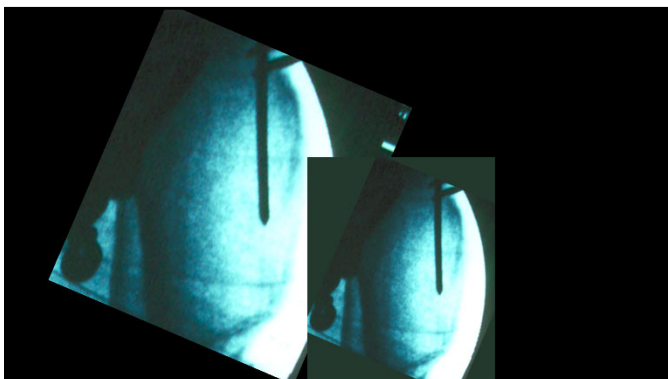
0% 25% 75%

50% medial 50% lateral

Fig. 1
per end of the tibia, showing the extra-synovial area of bone produced by passing a straight drill upwards along the tibia. Note that it encroaches only on the margin of the lateral articular facet. The black spots indicate suitable points of entry for a medullary nail.

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Proximal tibia fx
Which deformity can you expect?

Deformity rule:
deforms to side of higher fx line or wedge

example 1:
bending wedge lateral
• valgus deformity
• most common
• mostly impact from lateral (car bumper)

example 2:
• no bending wedge
deforms to the side higher fx line

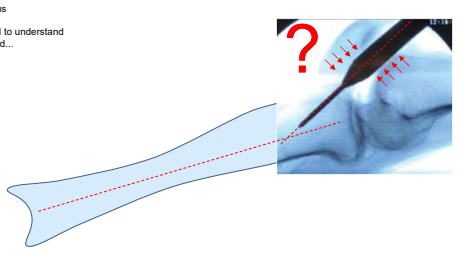
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Approach

options ...

- suprapatellar
- parapatellar
- trans Ligamentous
- ...
- promising ... hard to understand more data needed...




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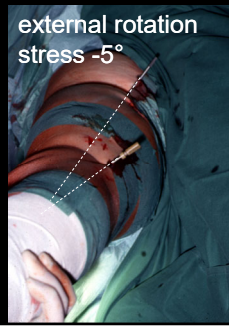
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Toggeling problems also in femoral nailing

internal rotation
stress +3°



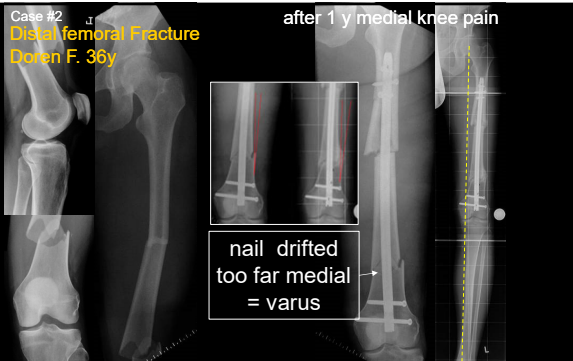
external rotation
stress -5°



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Case #2
Distal femoral Fracture
Doren F. 36y

after 1 y medial knee pain



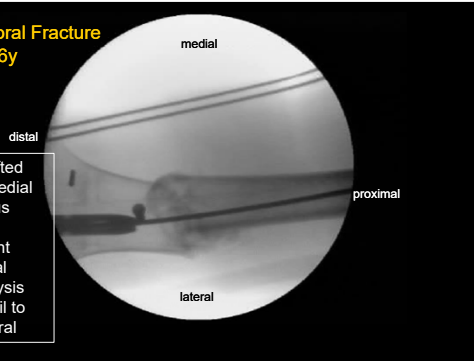
nail drifted too far medial = varus

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Case #2
Distal femoral Fracture
Doren F. 36y

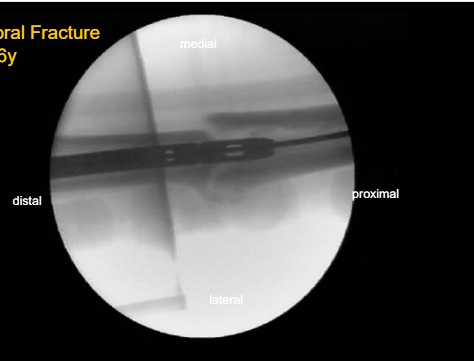


nail drifted too far medial = varus

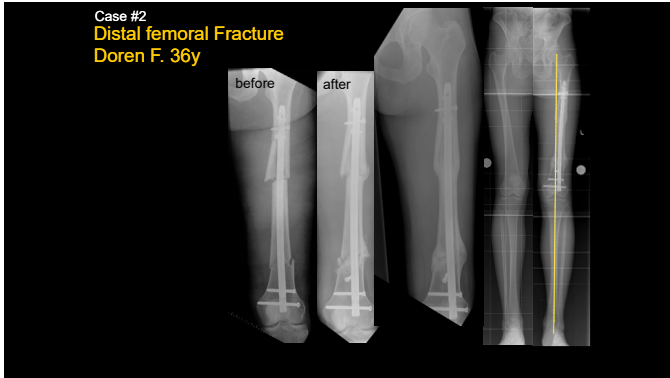
prevent medial metaphysis force nail to be lateral

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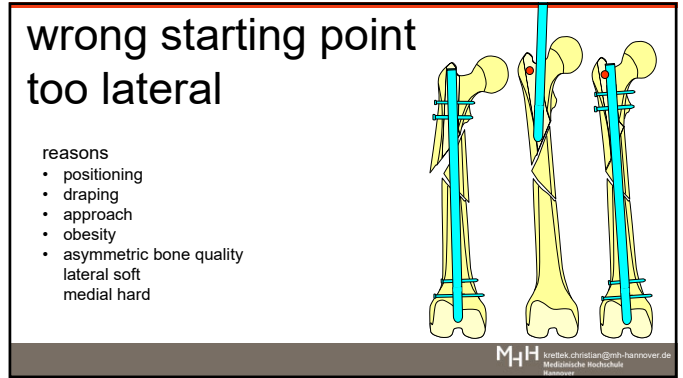
Case #2
Distal femoral Fracture
Doren F. 36y



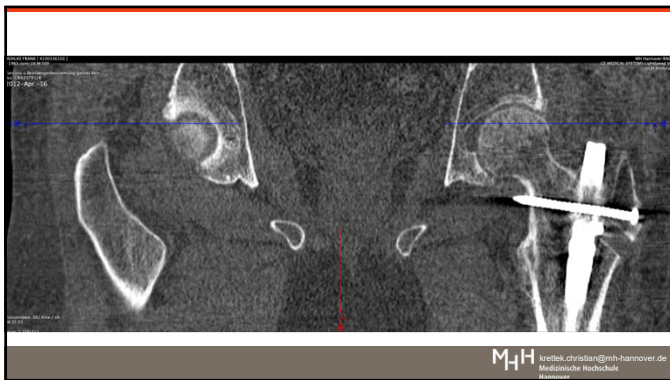
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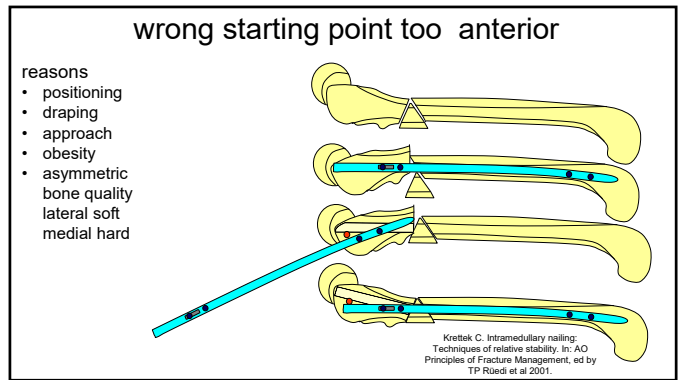
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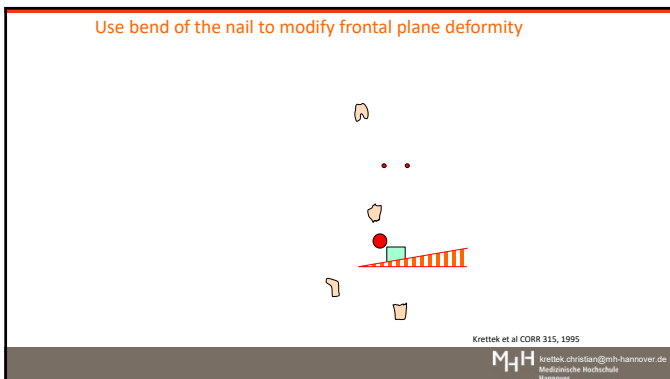
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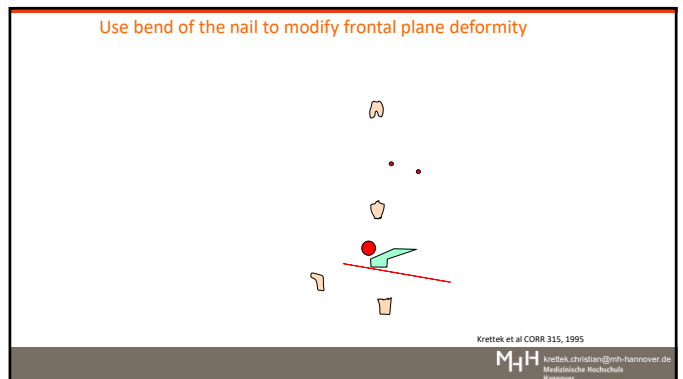
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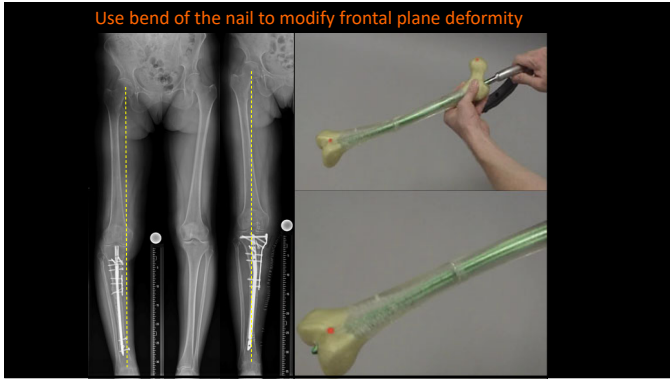
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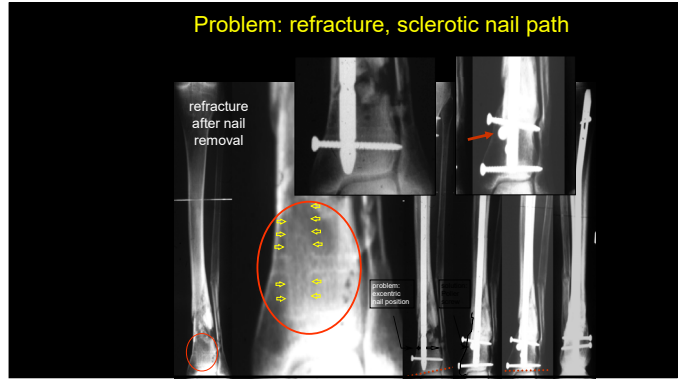
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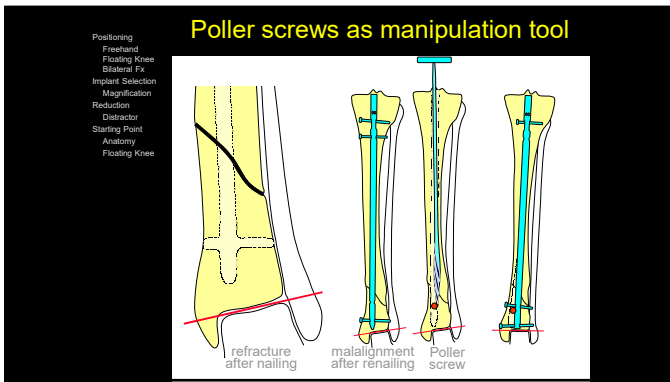
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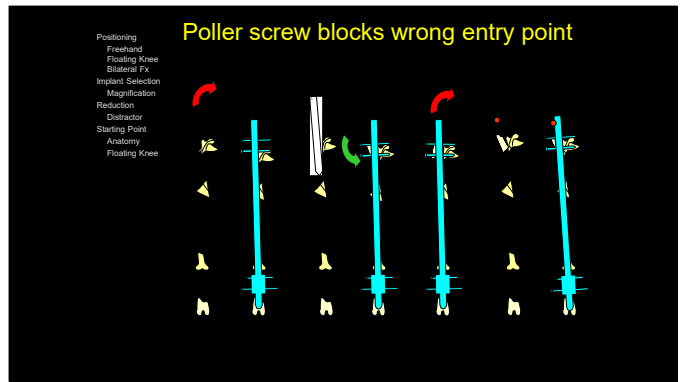
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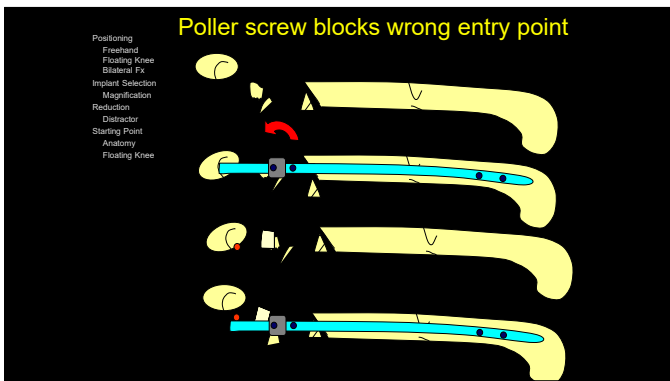
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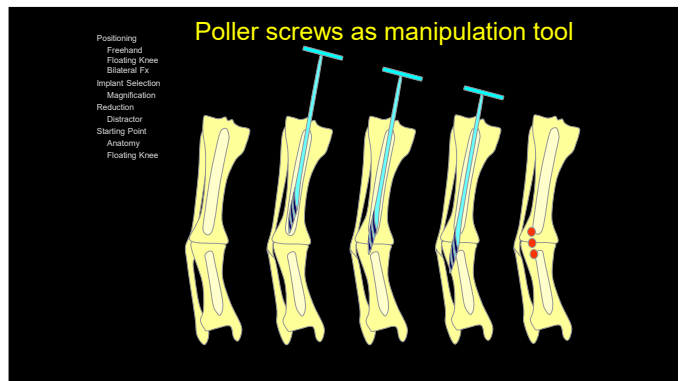
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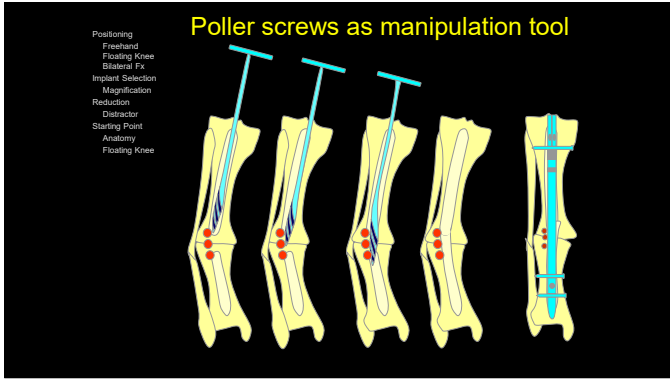
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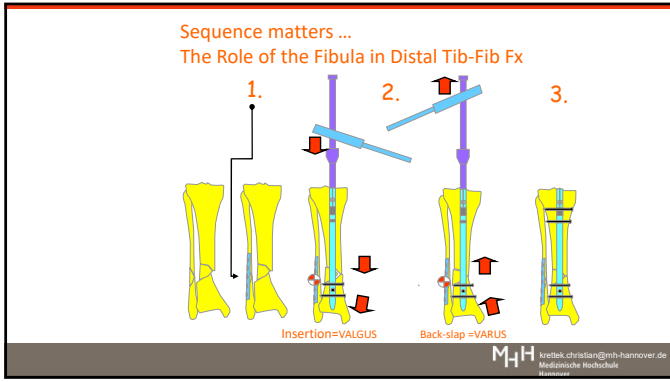
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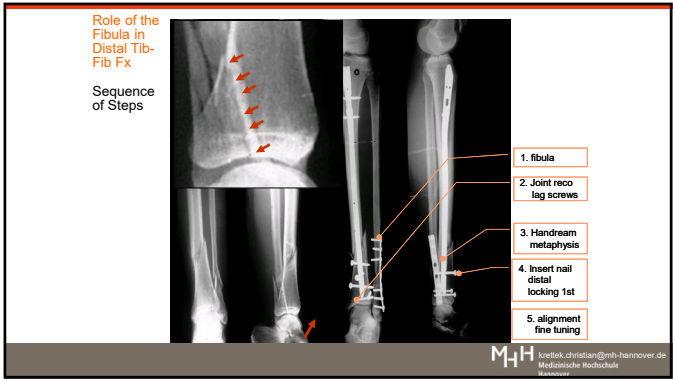
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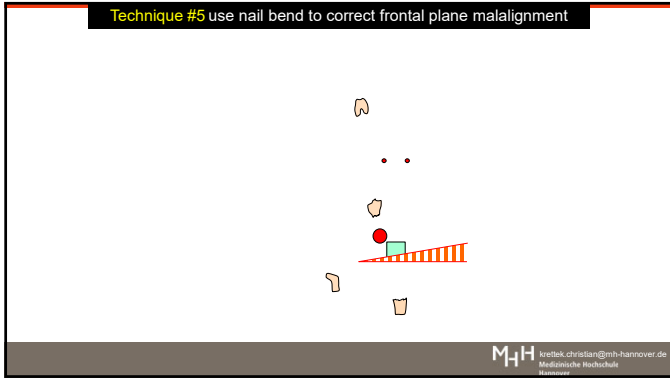
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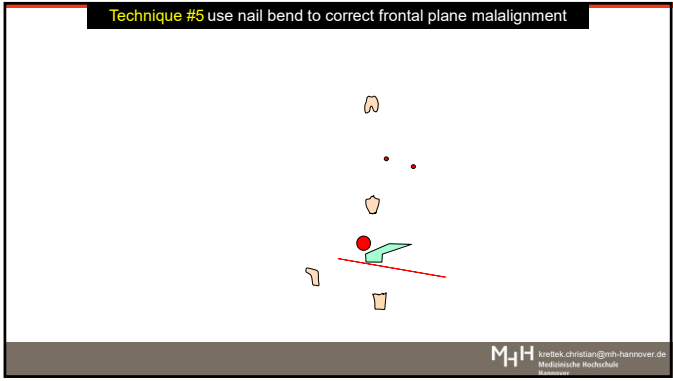
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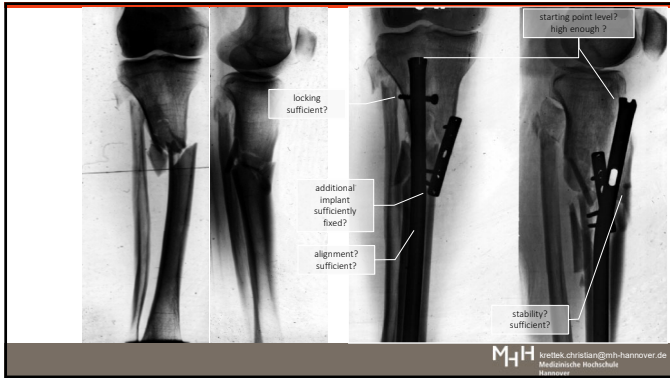
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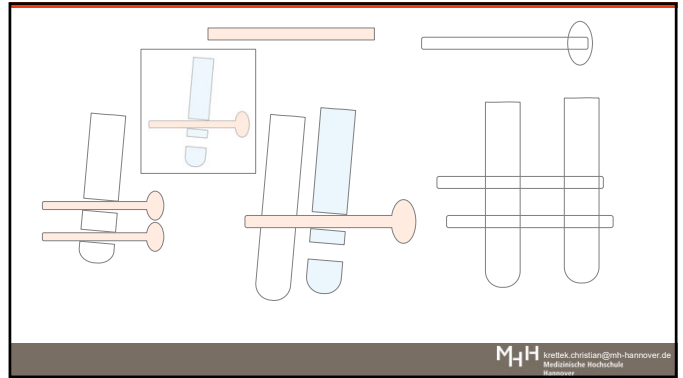
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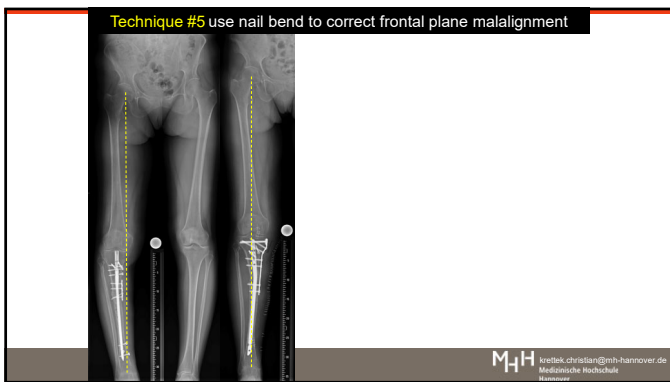
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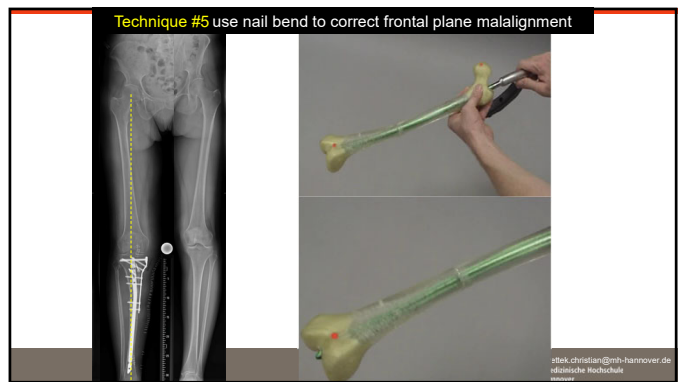
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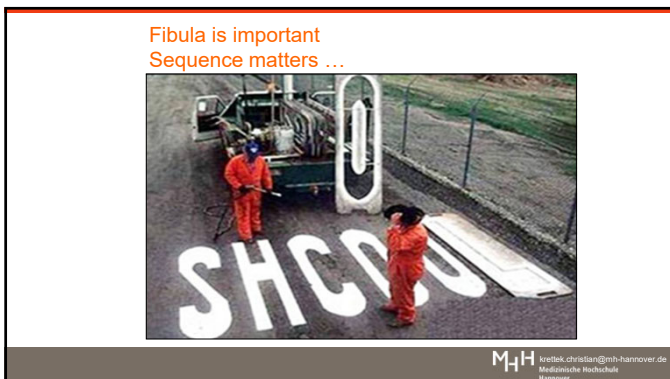
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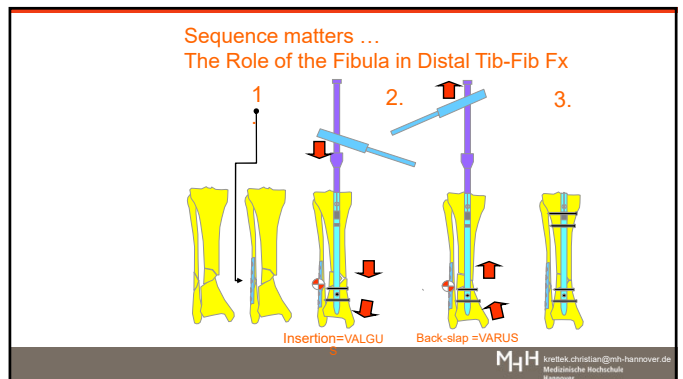
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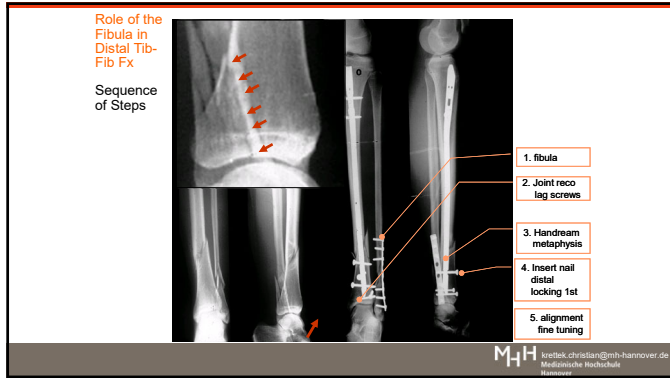
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#6 Understand General Rule in IM Nailing

Skin incision ...
... defines starting point
... starting point defines alignment

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