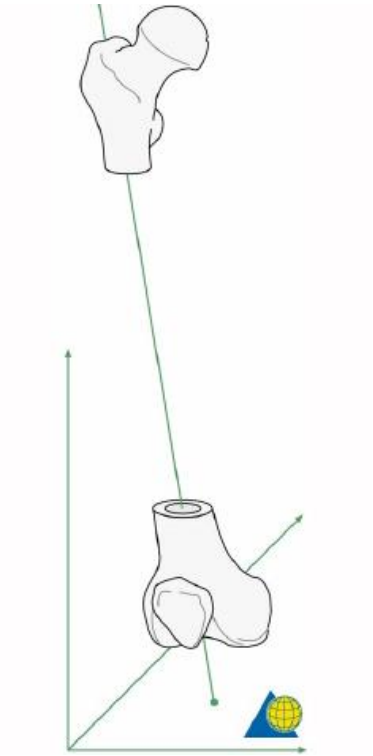
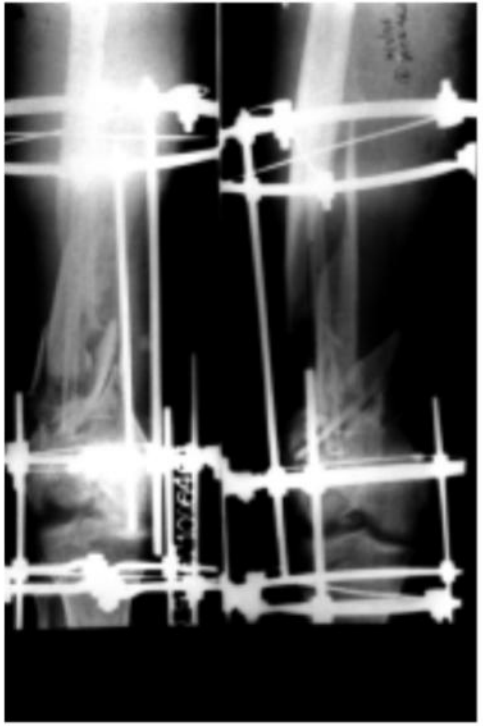


(a)



(c)

Journal of Orthopaedic Surgery 2004;12(1):91–95

- “varus is better than valgus!”

- “if the deformity is not seen clinically
- the reposition is successful!”

- “(in children) everything will be reconstructed!”

http://www.josonline.org/pdf/v12i1p91.pdf

Evaluation of fracture reduction accuracy.
Reference Lines and Angles (RLAs)

Leonid Solomin

Vreden Vreden National Medical Research Center of Traumatology and Orthopedics

http://rniito.org

SPb , 2022

Reference Lines and Angles (RLA)

Reference Lines:

- Anatomic axes
- Mechanical axes (common for limb and for each of bones)
- Joint lines

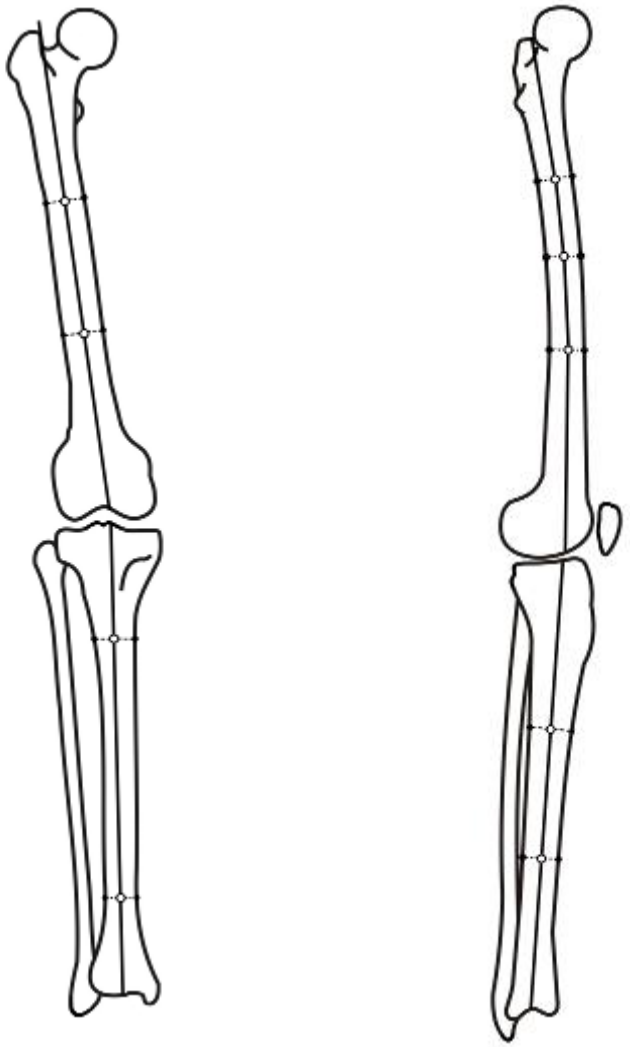
Reference Angles:

- Anatomic angles
- Mechanical angles

Note! All of these should be found both in frontal and sagittal planes

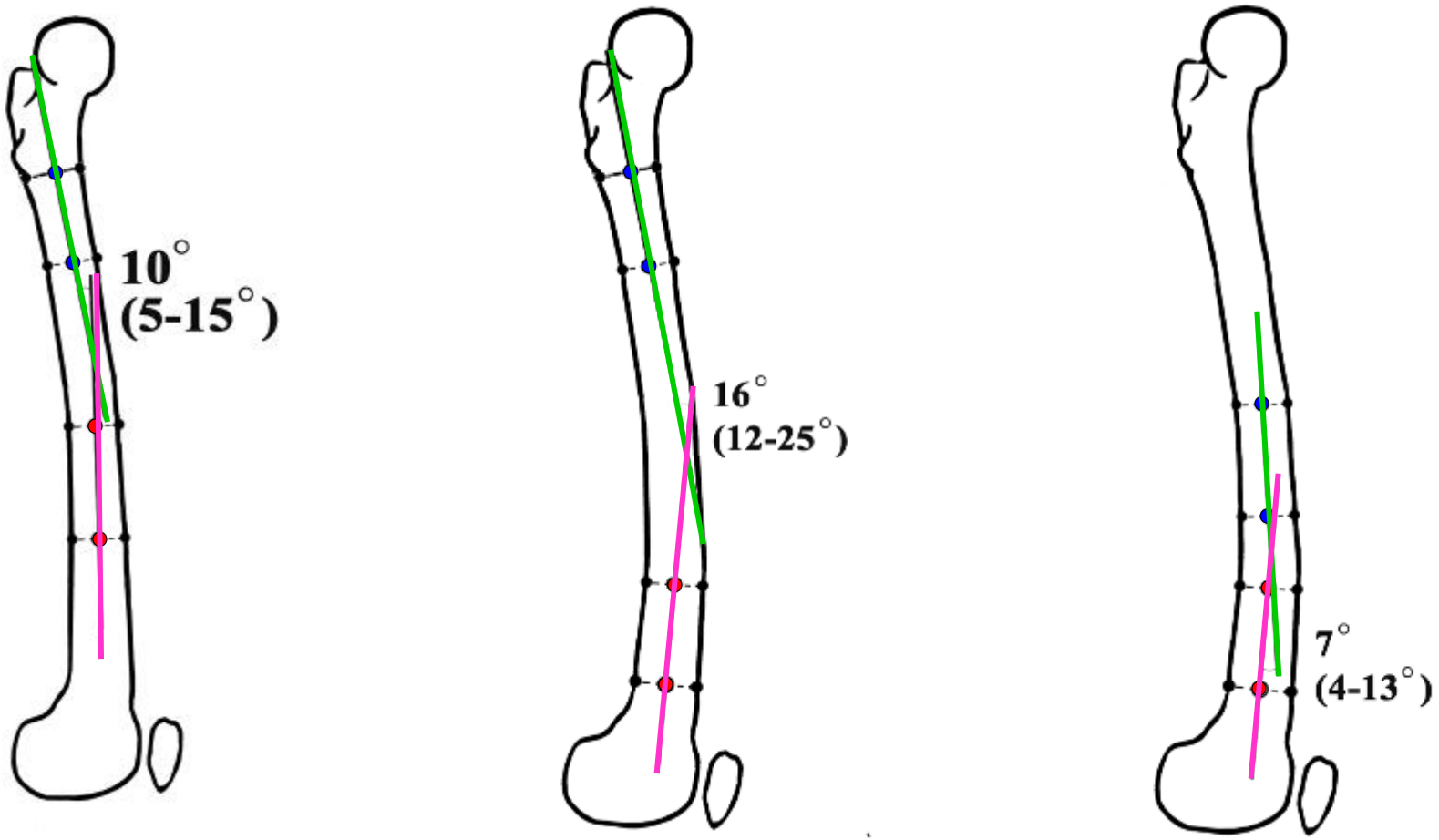
Anatomic Axis

mid-diaphyseal line



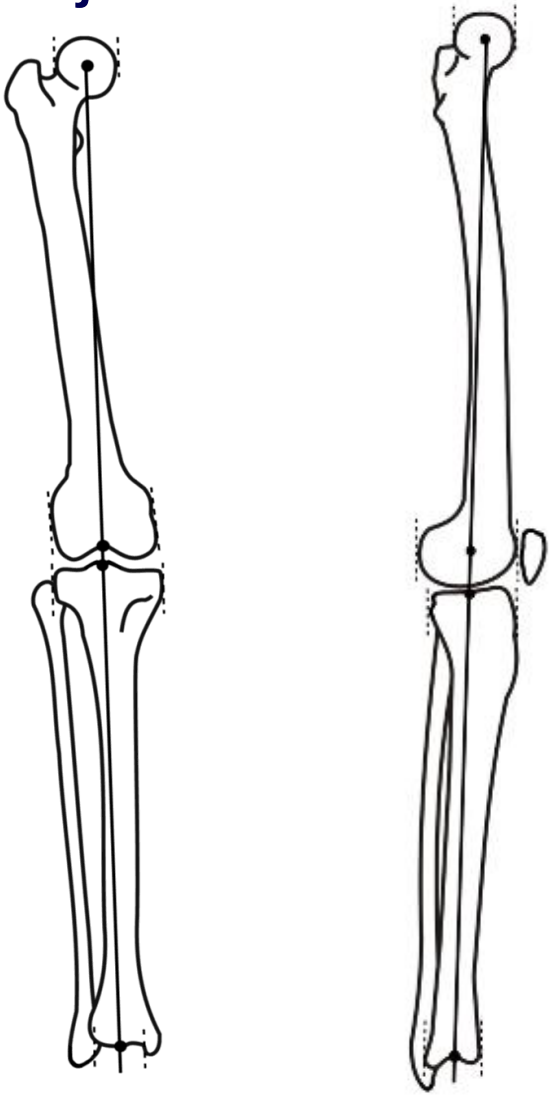
Anatomic Axis

femur, Lat

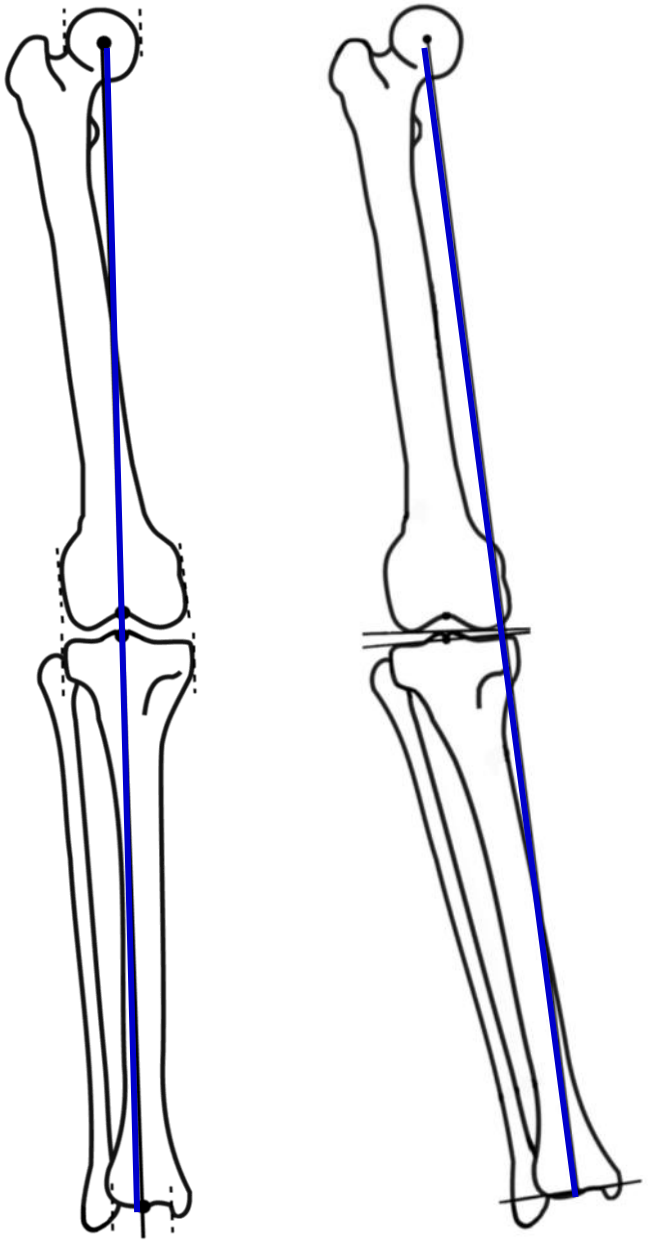


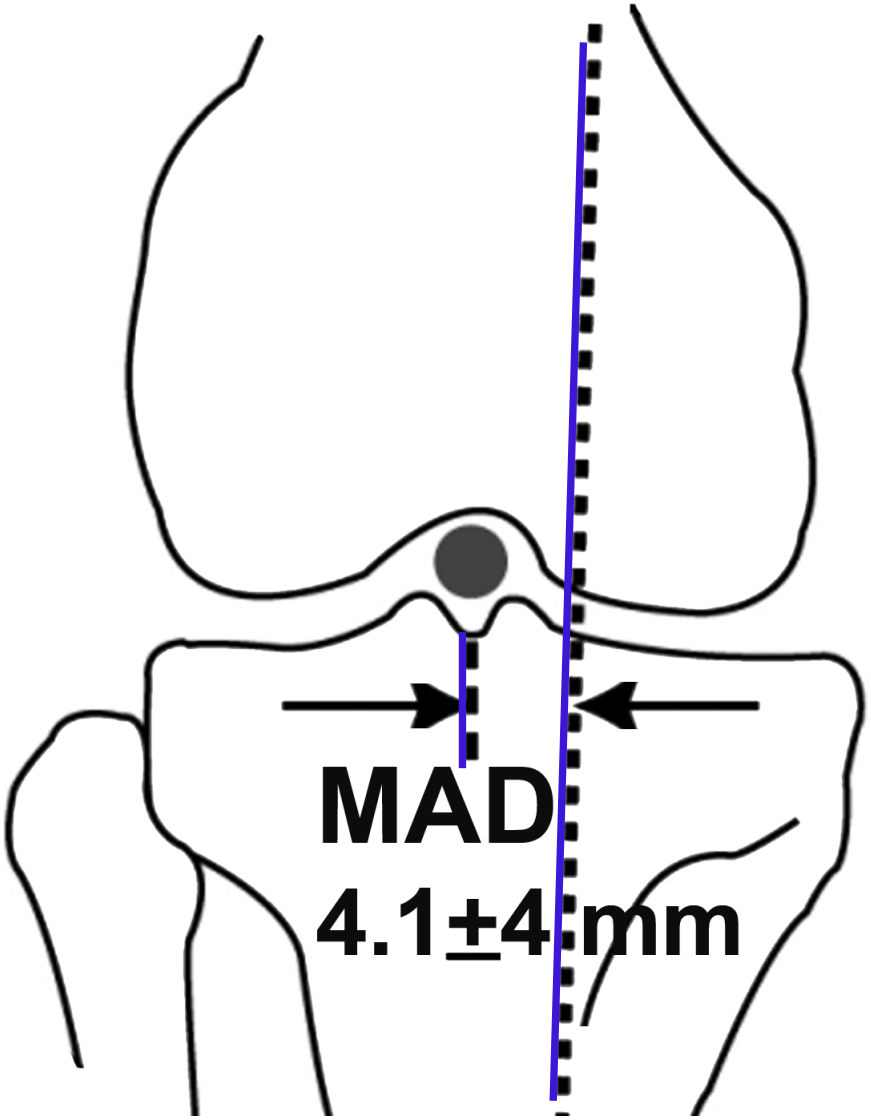
Common Mechanical Axis

straight line connecting the centers of proximal and distal joints of the limb



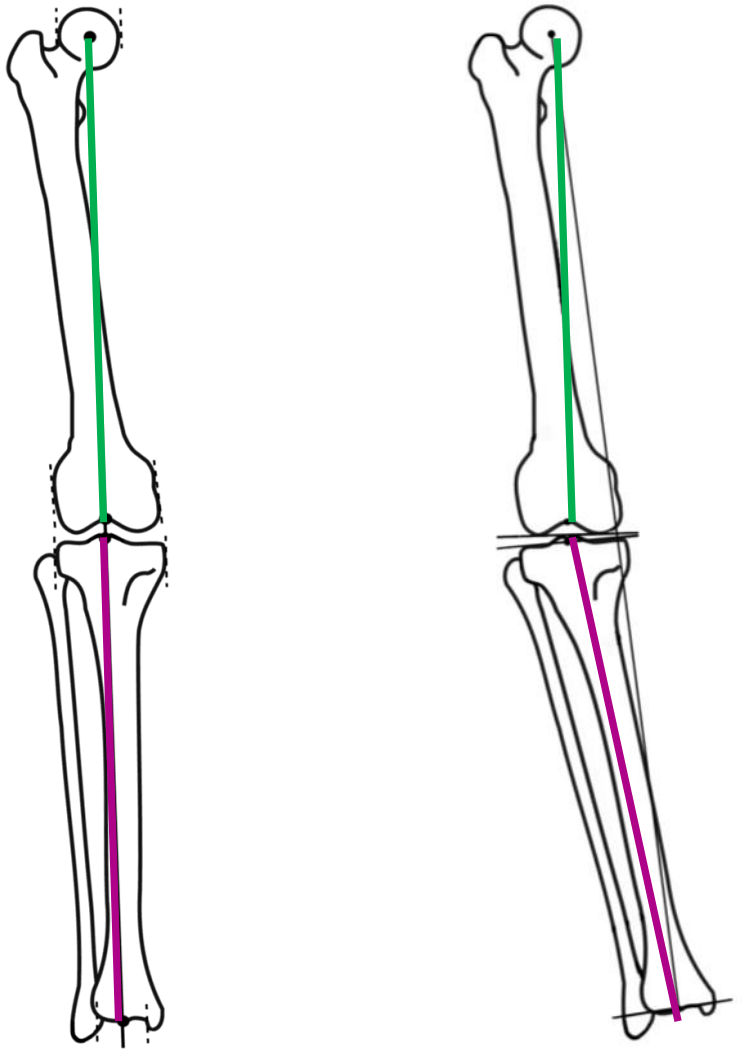
Mechanical Axis Deviation (MAD)





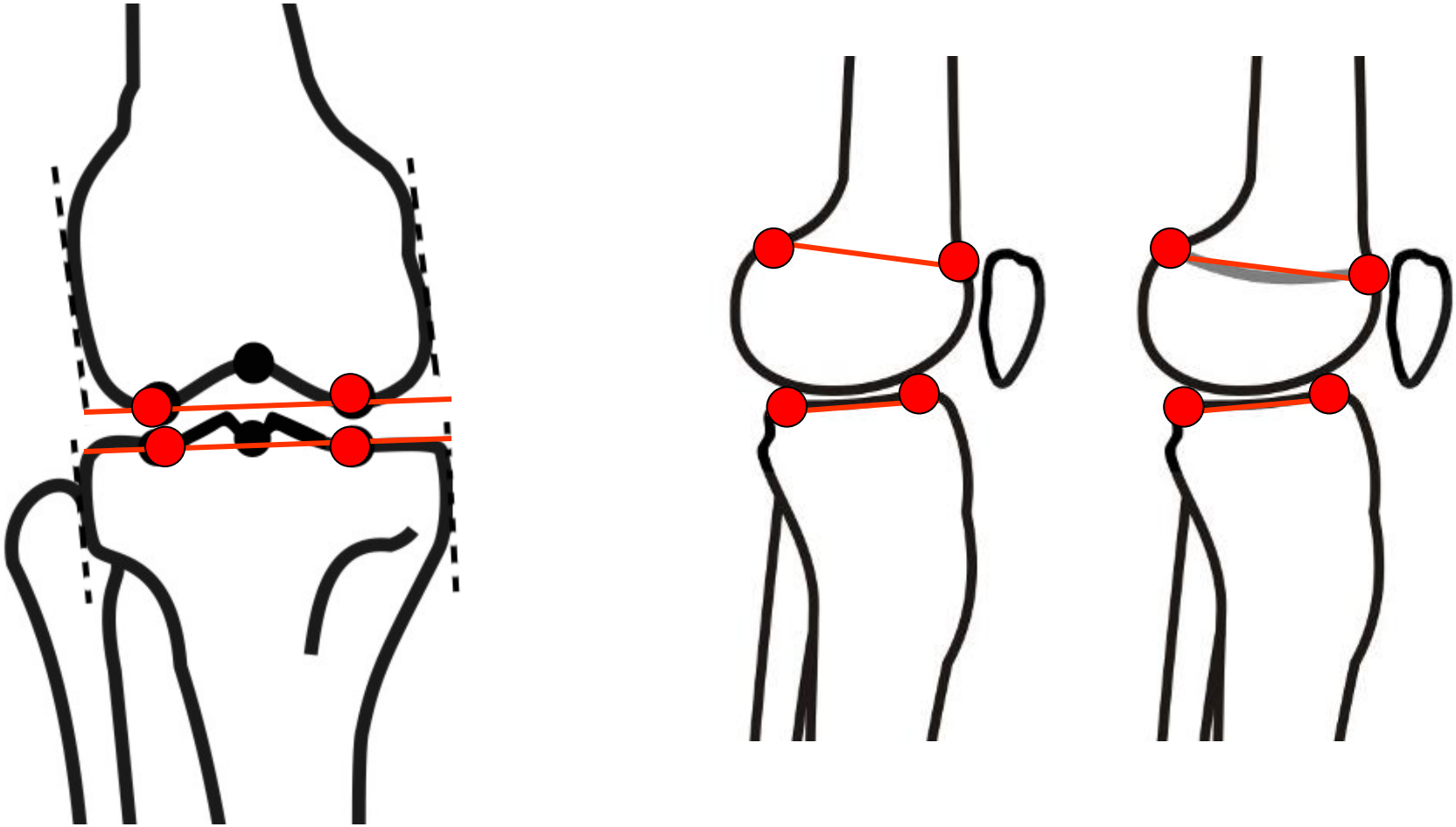
Mechanical Axes of Femur and Tibia

straight line connecting the joint centers *of the bone*



Joint (Orientation) Lines

are drawn using *joint reference points*



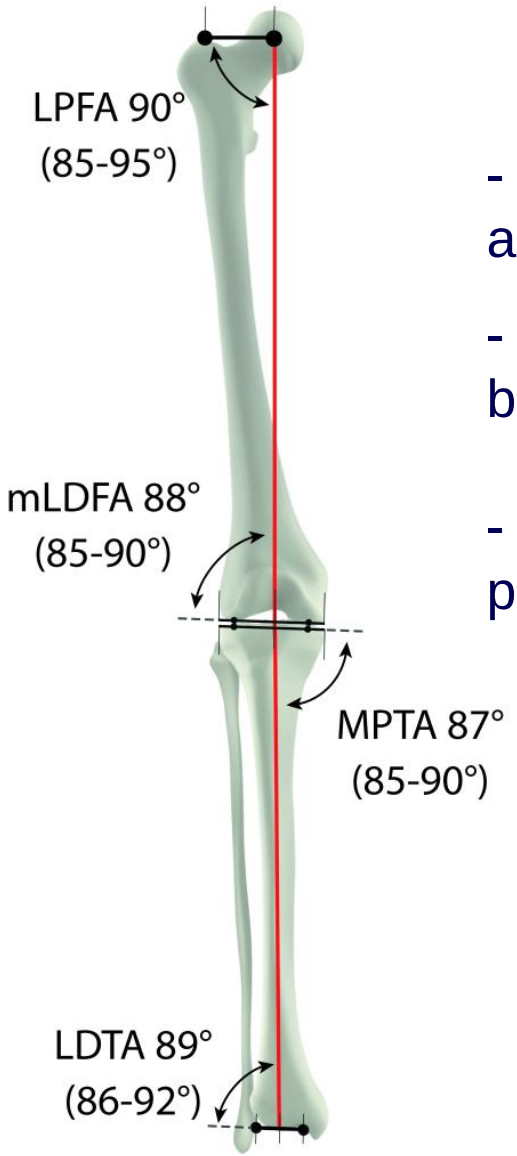
Reference Angles

- anatomic axes X joint lines =
anatomic angles

- mechanical axes X joint lines =
mechanical angles

Note! All of these should be found both in frontal and sagittal planes

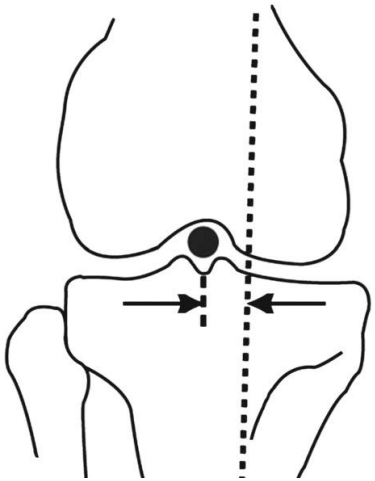
Mechanical Angles

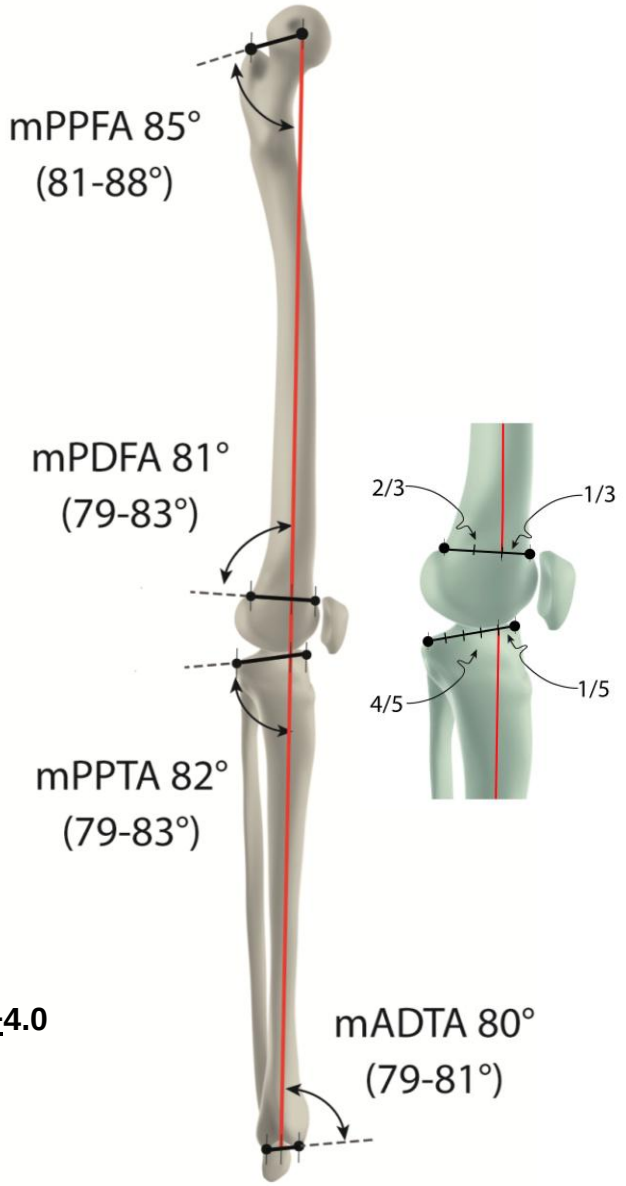


- by crossing a mechanical axis with joint lines

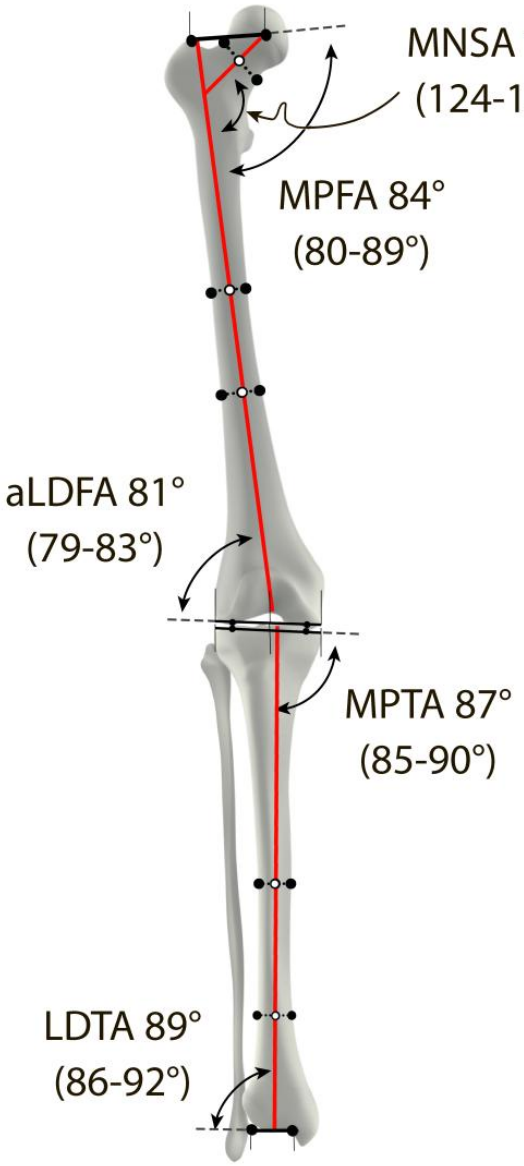
- proximal and distal for each bone

- for frontal and sagittal planes

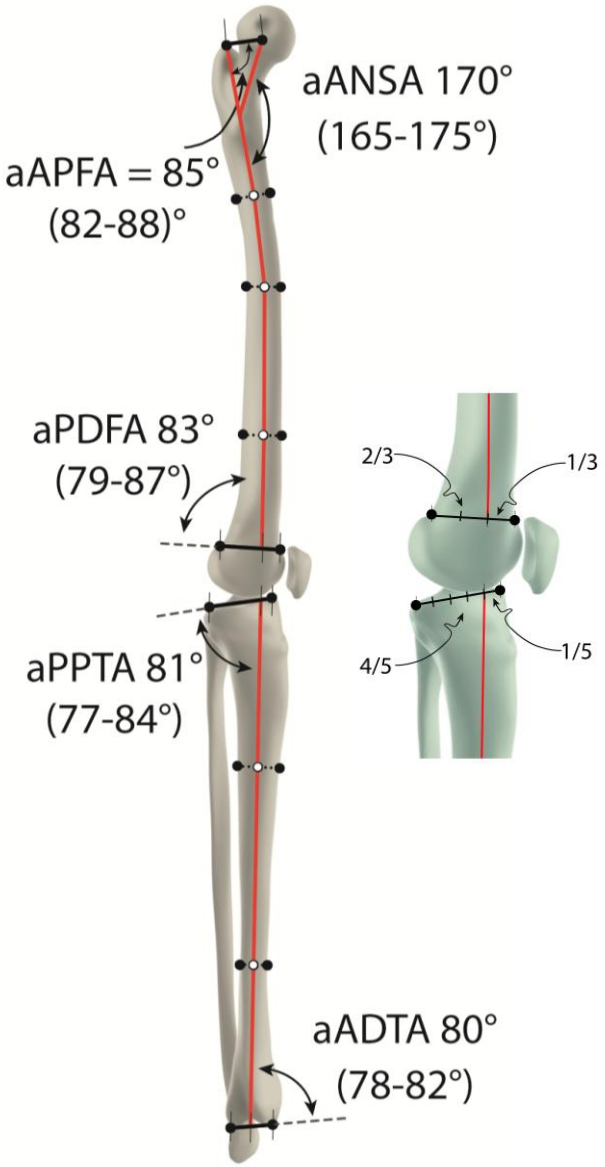




Anatomic Angles



- by crossing an anatomic axis with joint lines
- proximal and distal for each bone
- for frontal and sagittal planes

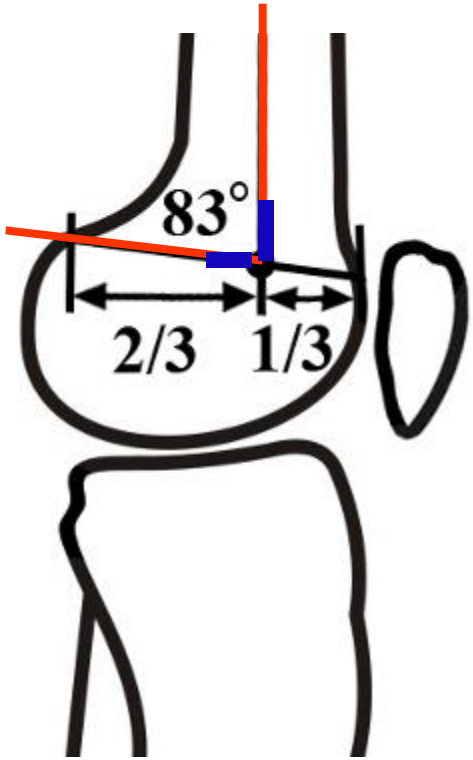


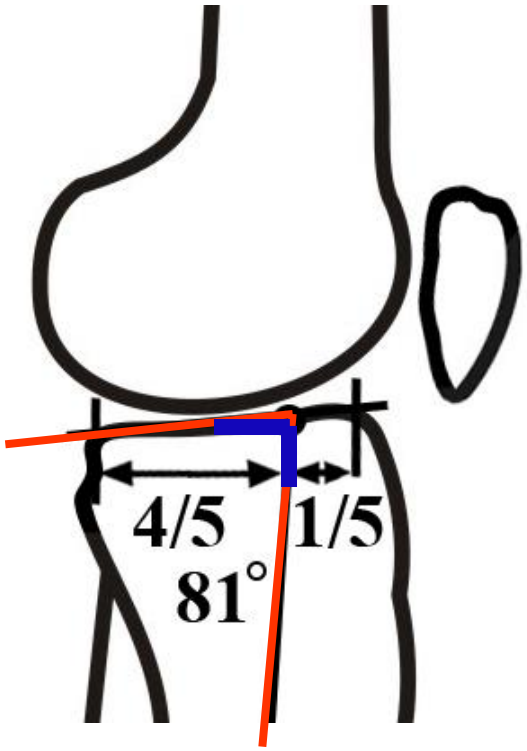
Reference Angles Nomenclature

abbreviation	complete title	average normal value and range
MAD	mechanical axis deviation	0 (3 lat. - 8 med.) mm
	Mechanical angles of femur	
LPFA	lateral proximal femoral angle	90° (85-95°)
mLDFA	mechanical lateral distal femoral angle	88° (85-90°)
mPPFA	mechanical posterior proximal femoral angle	85° (81-88°)
mPDFA	mechanical posterior distal femoral angle	81° (79-83°)
	Mechanical angles of tibia	
mMPTA	mechanical medial proximal tibial angle	87° (85-90°)
mLDTA	mechanical lateral distal tibial angle	89° (86-92°)
mPPTA	mechanical posterior proximal tibial angle	82° (79-83°)
mADTA	mechanical anterior distal tibial angle	80° (79-81°)
	Anatomic angles of femur	
MPFA	medial proximal femoral angle	84° (80-89°)
MNSA	medial neck shaft angle	130° (124-136°)
aLDFA	anatomic lateral distal femoral	81° (79-83°)
aAPFA	anatomic anterior proximal femoral angle	85° (82-88°)
ANSA	anterior neck shaft angle	170° (165-175°)
aPDFA	anatomic posterior distal femoral angle	83° (79-87°)
	Anatomic angles of tibia	
aMPTA	anatomic medial proximal tibial angle	87° (85-90°)
aLDTA	anatomic lateral distal tibial angle	89° (86-92°)
aPPTA	anatomic posterior proximal tibial angle	81° (77-84°)
aADTA	anatomic anterior distal tibial angle	80° (78-82°)
	Addition angles	
JLCA	joint line convergence angle	0-2°
AMA	anatomic-mechanical angle	7° (5-9°)
mTFA	Mechanical tibiofemoral angle	0-1.3° varus
aTFA	Anatomic tibiofemoral angle	6-7° varus

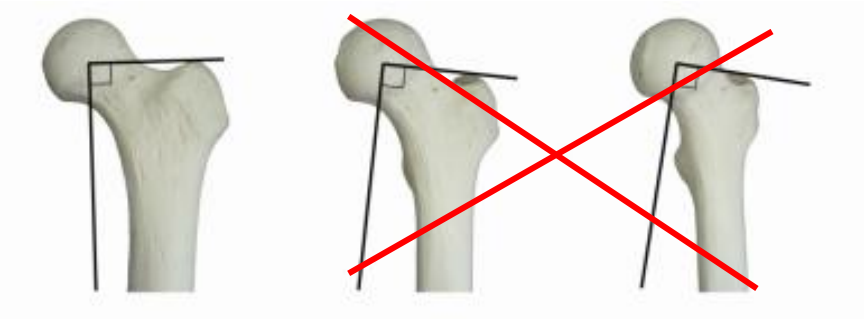
Note!

The vertex of anatomic and mechanical angle should be *at a definite point of joint line*. These points along with anatomic and mechanical angles *are specific ones* for each of bone



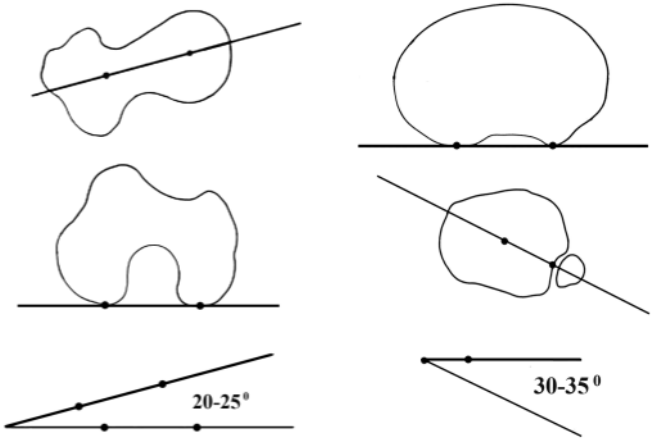


Attention: “trap”!
(rotational malalingment)



Mechanical axis

Anatomical axis



Reduction accuracy evaluation steps

- Torsion component of malreduction evaluation

- Joint lines identification
- Mechanical axis identification
- Mechanical angles evaluation

- LLD evaluation

Reduction accuracy evaluation steps

- Torsion component of malreduction evaluation

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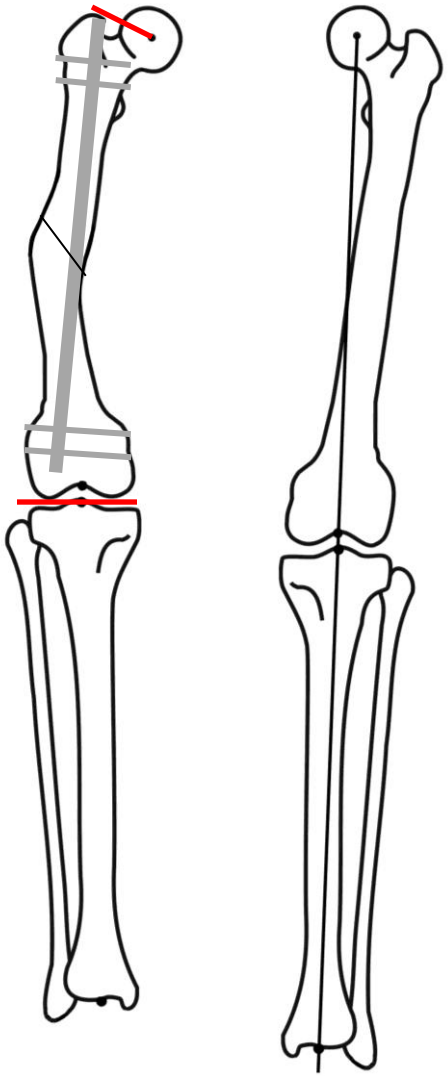
Reduction accuracy evaluation steps: femur

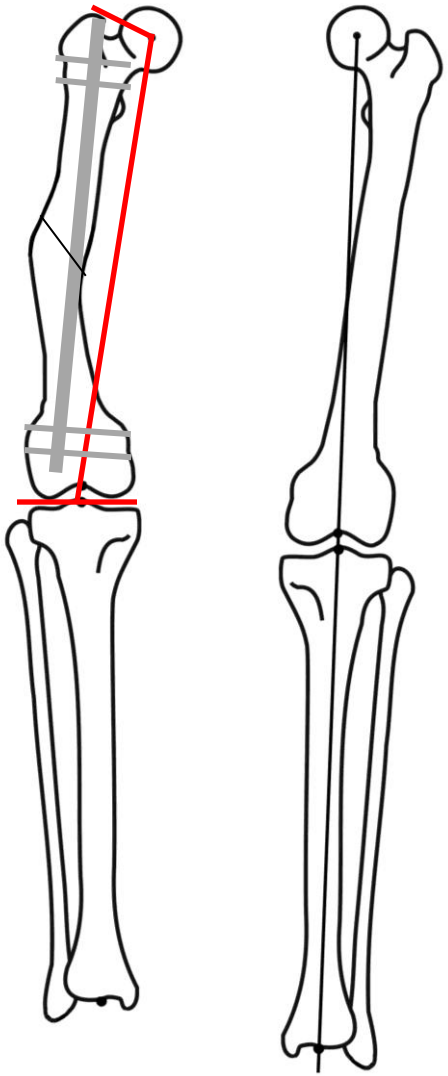


- Torsion component of malreduction evaluation

- **Joint lines identification**
- Mechanical axis identification
- Mechanical angles evaluation

- LLD evaluation

Reduction accuracy evaluation steps: femur

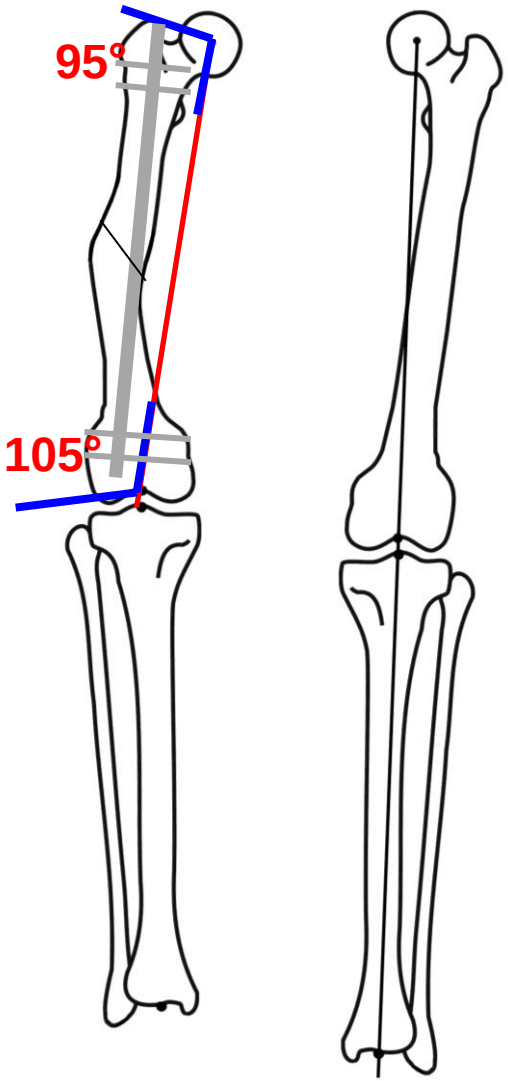


- Torsion component of malreduction evaluation

- Joint lines identification
- **Mechanical axis identification**
- Mechanical angles evaluation

- LLD evaluation

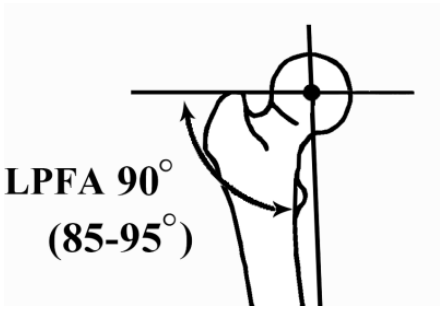
Reduction accuracy evaluation steps: femur

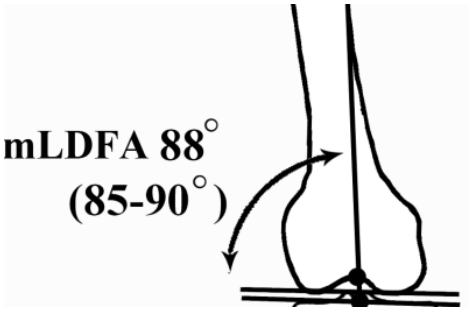


- Torsion component of malreduction evaluation

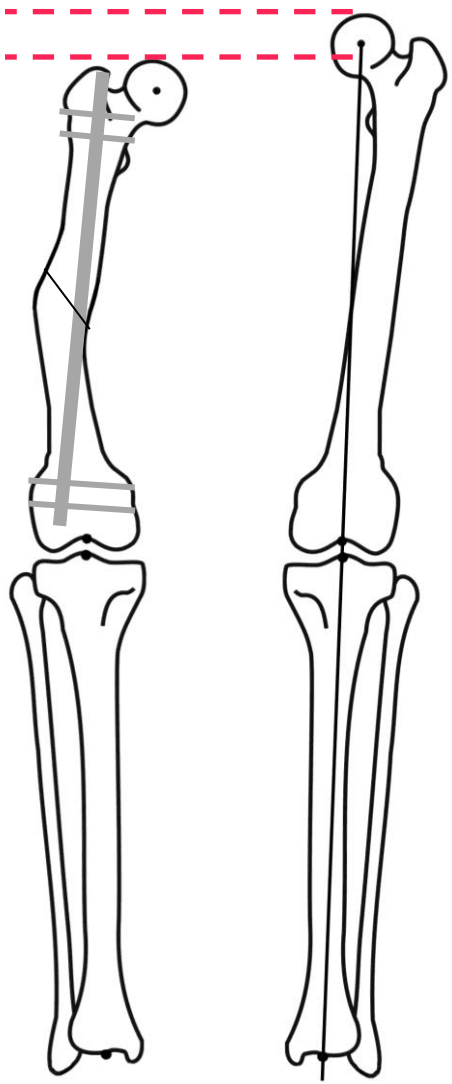
- Joint lines identification
- Mechanical axis identification
- **Mechanical angles evaluation: mLPFA, mLDFA**

- LLD evaluation





Reduction accuracy evaluation steps

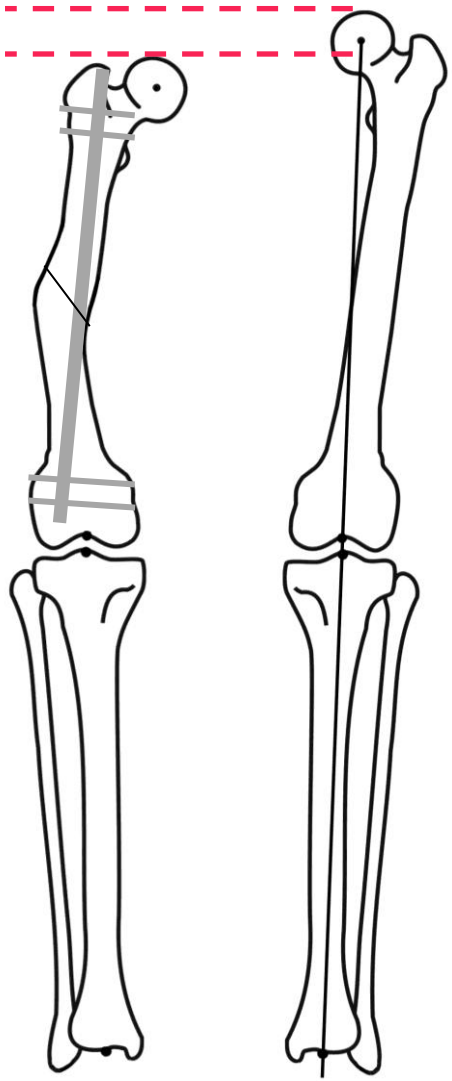


- Torsion component of malreduction evaluation

- Joint lines identification
- Mechanical axis identification
- Mechanical angles evaluation: mLPFA, mLDFA

- **LLD evaluation**

Reduction accuracy evaluation steps



- Torsion component of malreduction evaluation

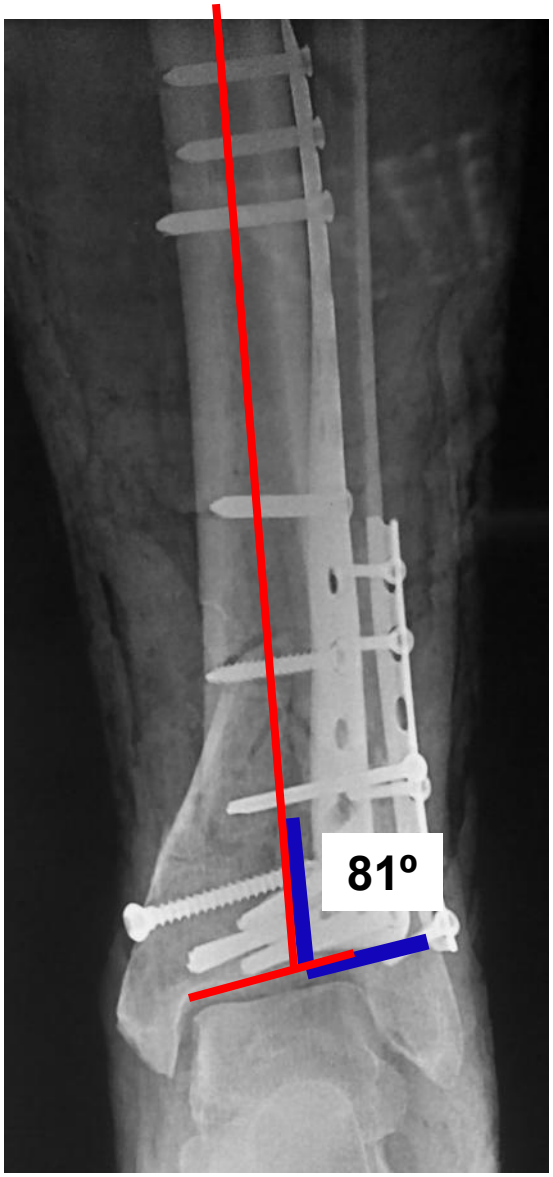
- Joint lines identification
- Mechanical axis identification
- Mechanical angles evaluation: mLPFA, mLDFA

- **LLD evaluation**

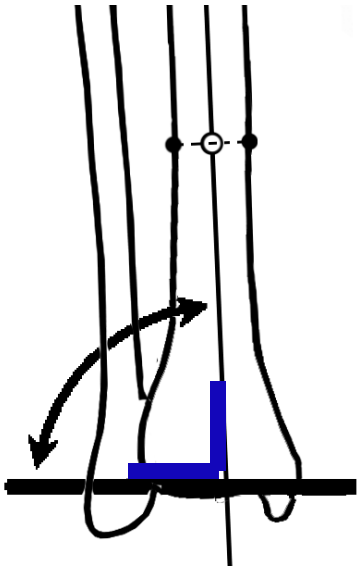
Conclusion:
There is malreduction: angulation and shortening

Is there malreduction?

Is there malreduction? – YES (?)

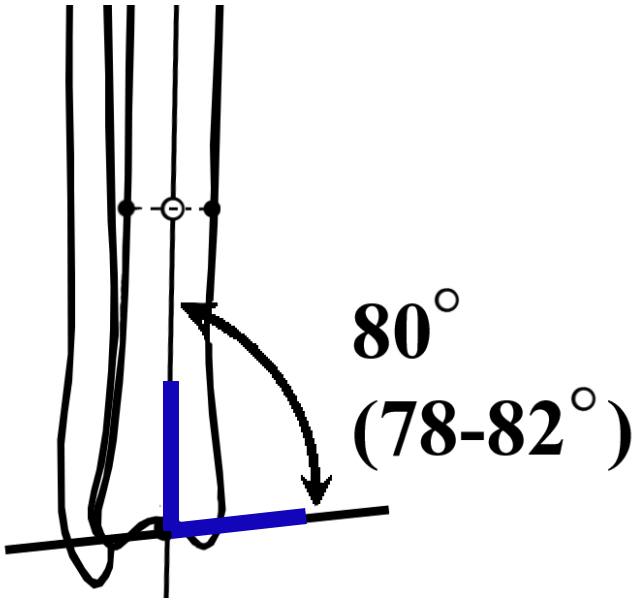


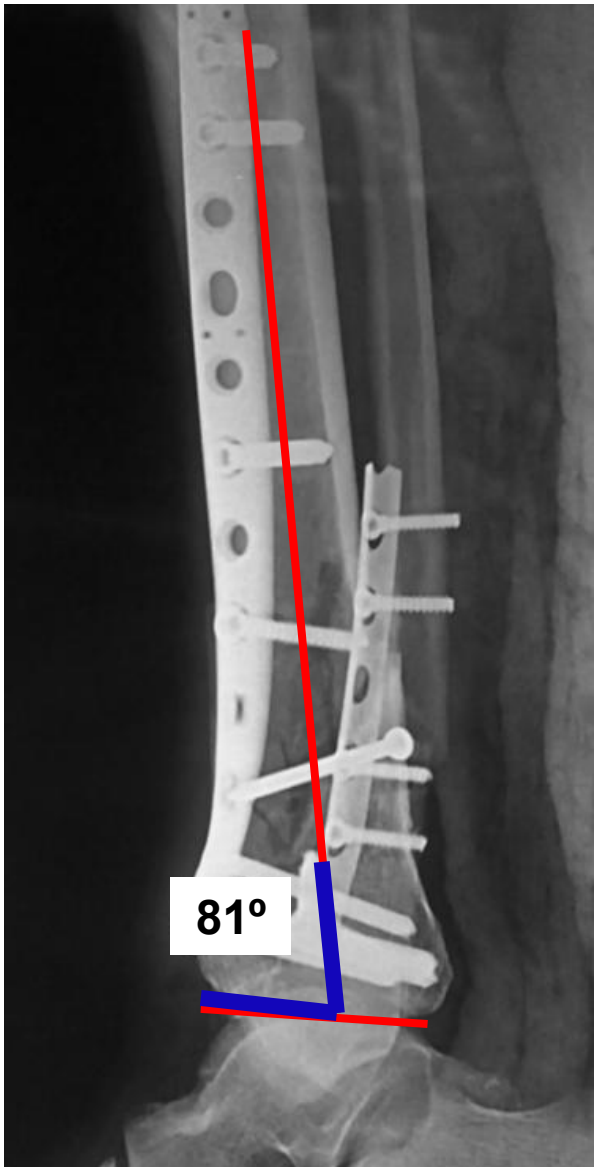
89°
(86-92°)



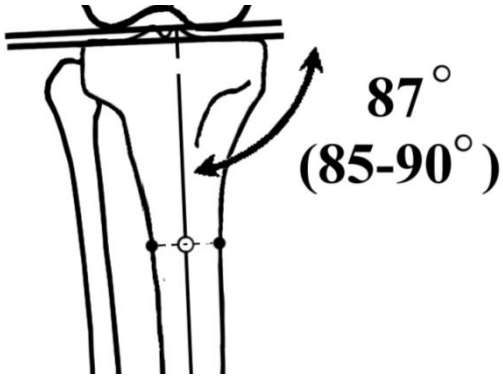
Is there malreduction?

Is there malreduction? – NO (?)

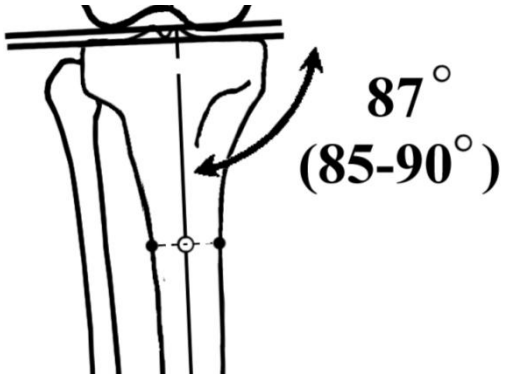




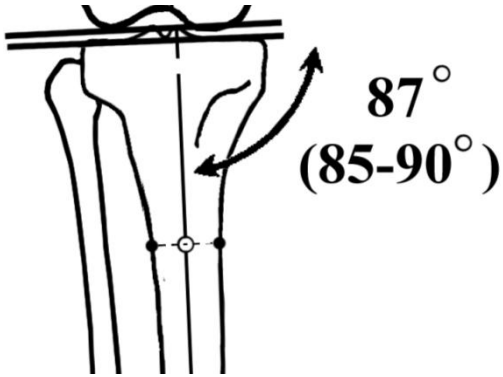
Is there malreduction? – YES (?)



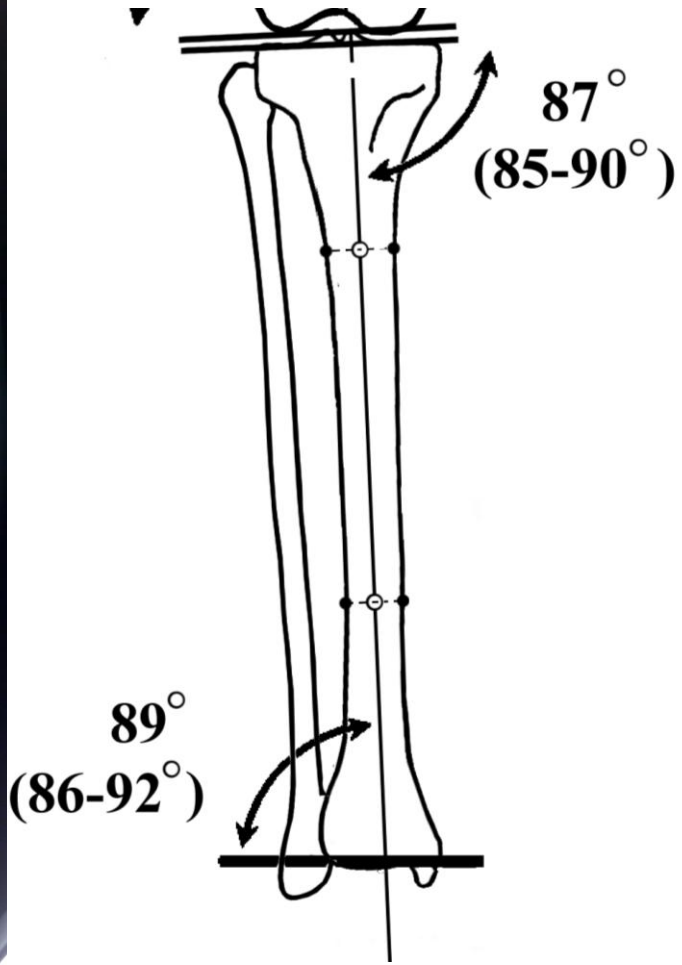
Is there malreduction? – YES (?)



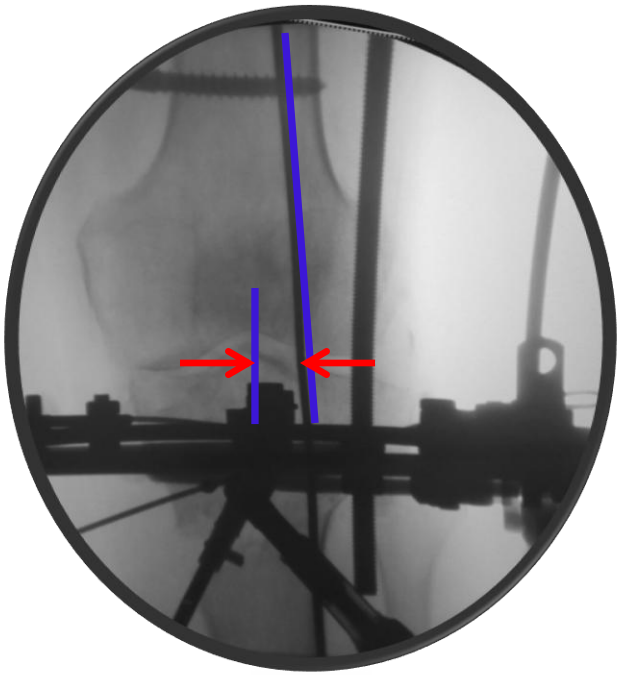
Is there malreduction? – YES (?)



There is no malreduction!

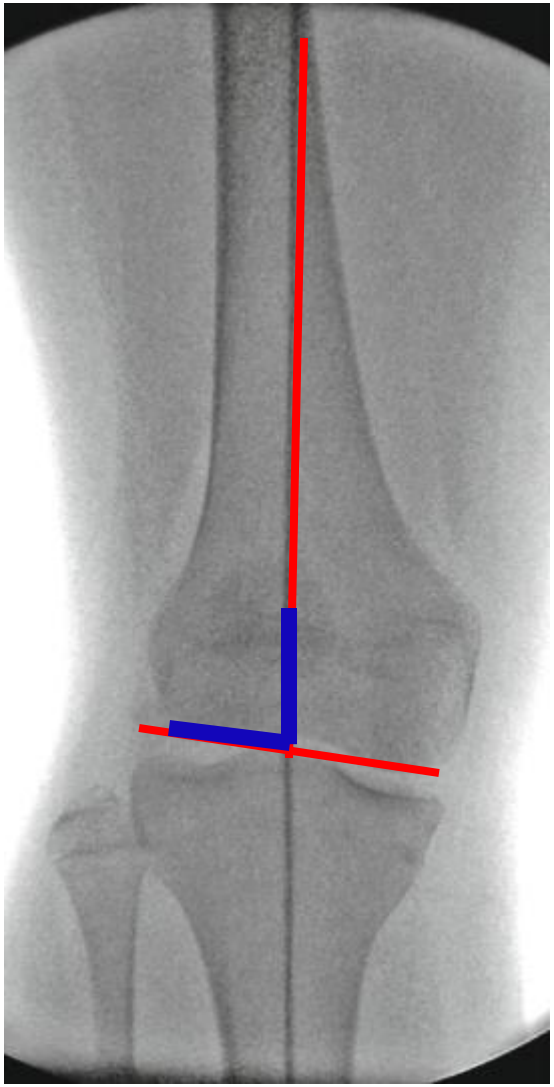


Intraoperative control: Cable technique

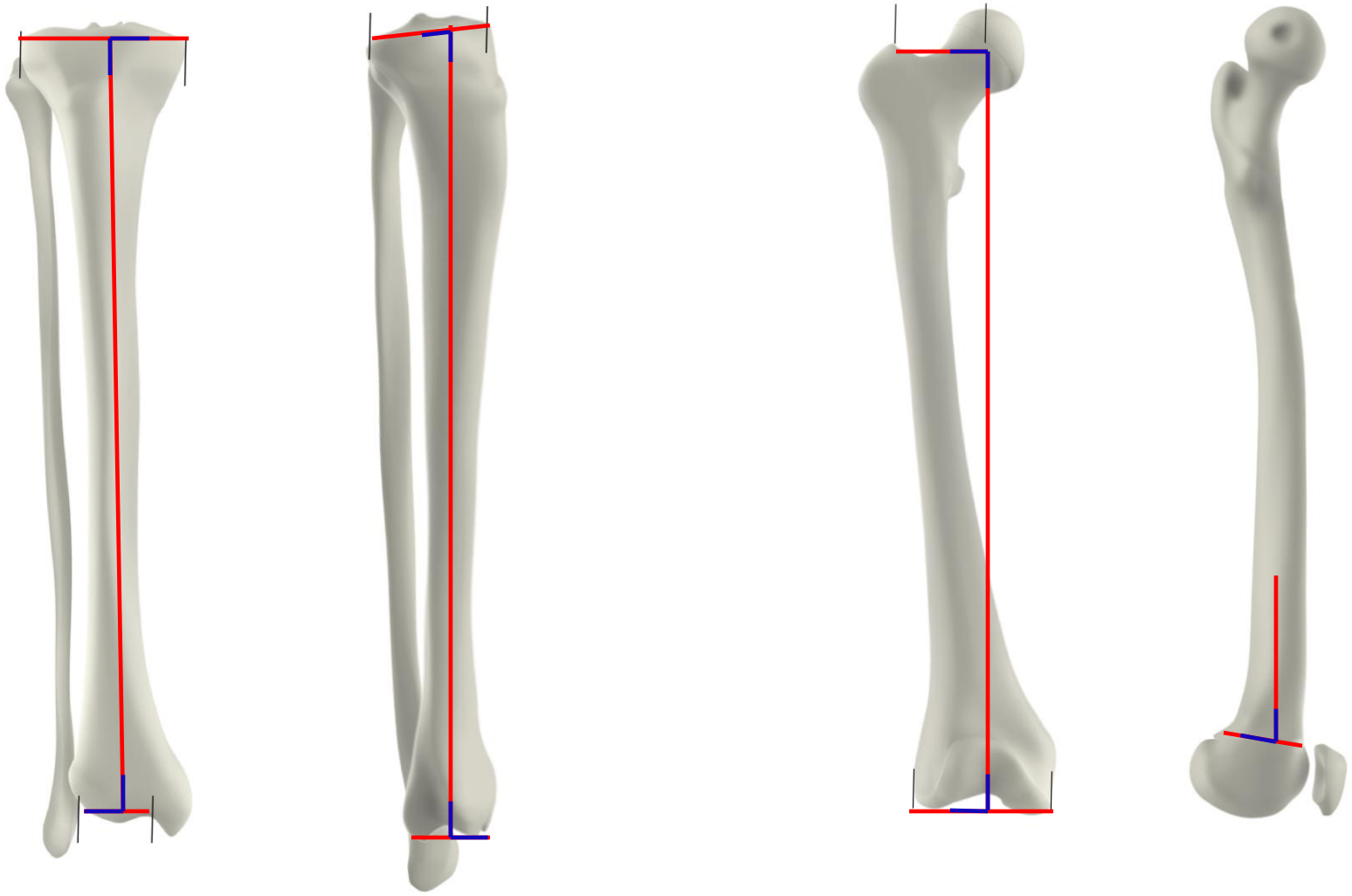


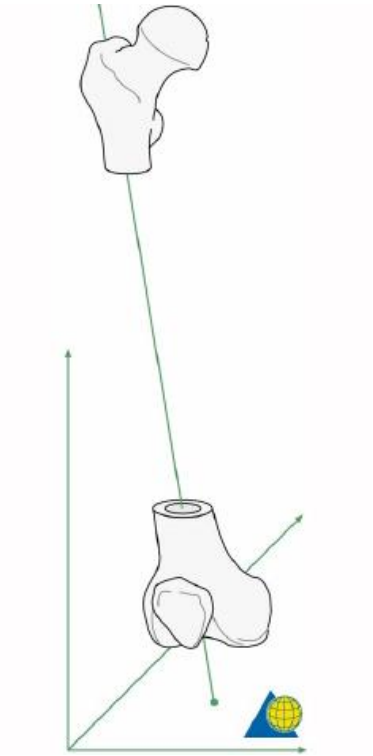
Intraoperative control: Cable technique

Intraoperative control: Cable technique



Take-home message: 3 lines & 2 angles





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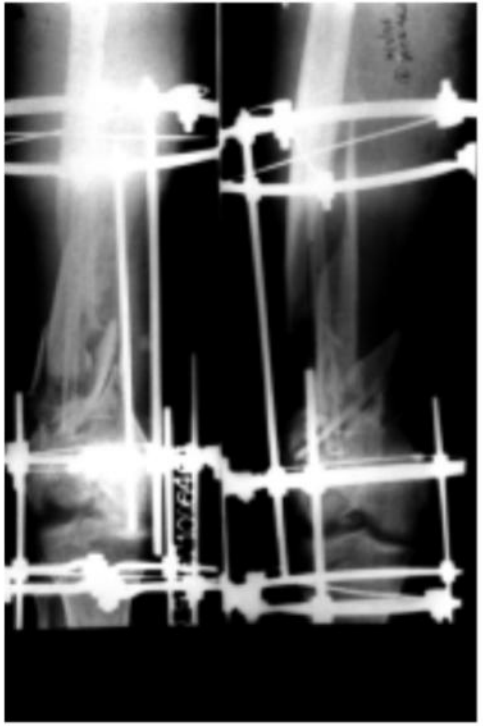


(c)

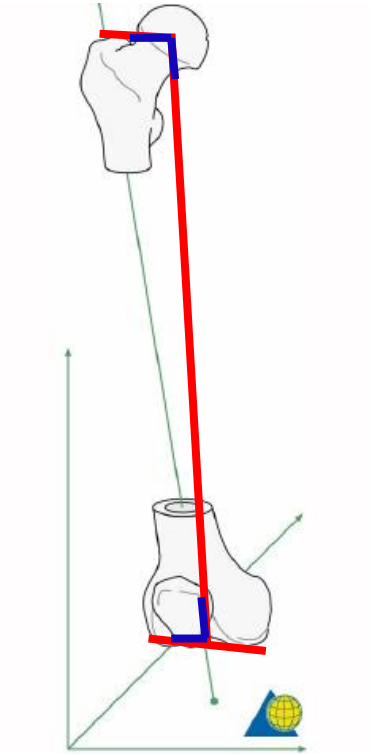
Journal of Orthopaedic Surgery 2004;12(1):91–95

- “varus is better than valgus!”

- “if the deformity is not seen clinically
- the reposition is successful!”

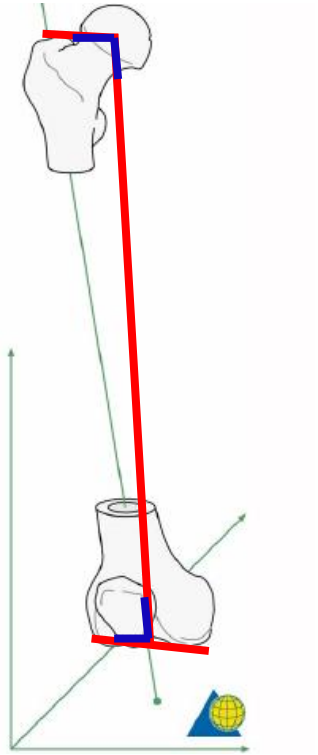
- “(in children) everything will be reconstructed!”

http://www.josonline.org/pdf/v12i1p91.pdf



Take-home message

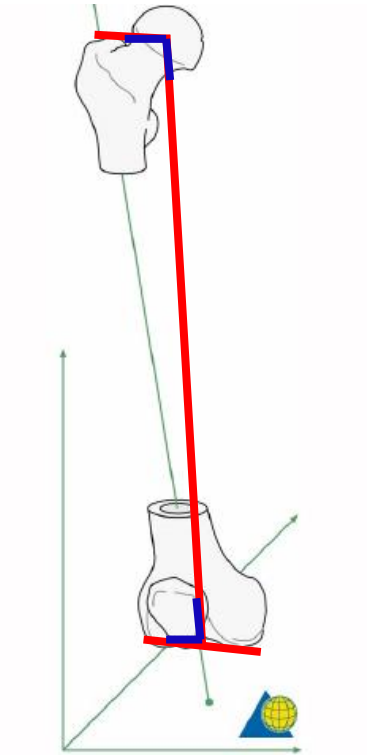
- axis
- length
- rotation
- joint angles

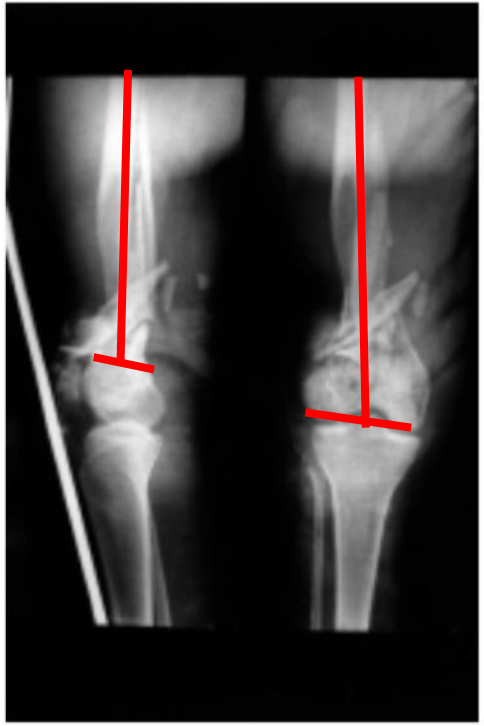


Take-home message

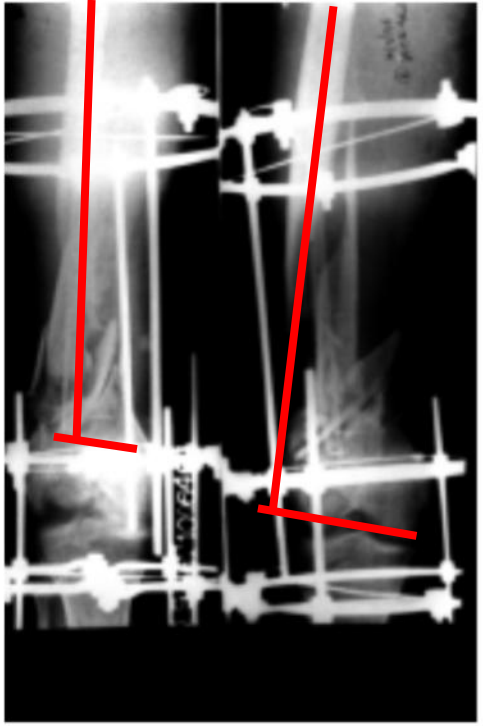
- axis
- length
- rotation
- joint angles

- In the presence of torsion, do not evaluate the joint angles!





(a)



(c)

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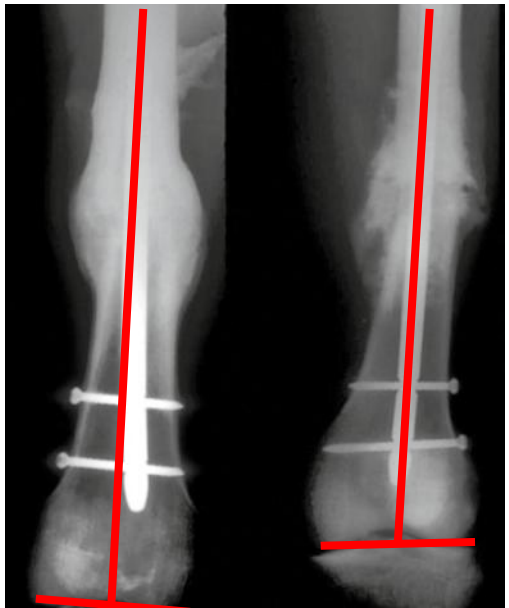

Take-home message:

do not create deformities!!!

http://www.josonline.org/pdf/v12i1p91.pdf