

San Francisco Trauma Course 2022

Management of Distal Femur Fracture Defects



Christian Krettek



Causes for large articular defects (>4 cm)

1. Osteonecrosis
 2. Arthritis
 3. Charcot joint
 4. Tumor (destruction, resection)
 5. Trauma (destruction, complete mechanical loss)
 6. Infection (post debridement)
- Literature: few evidence for clinical management

warning



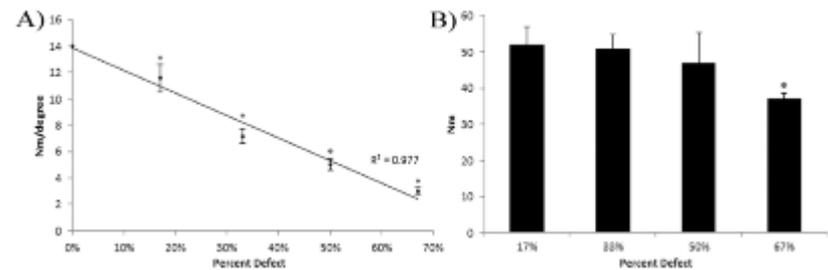
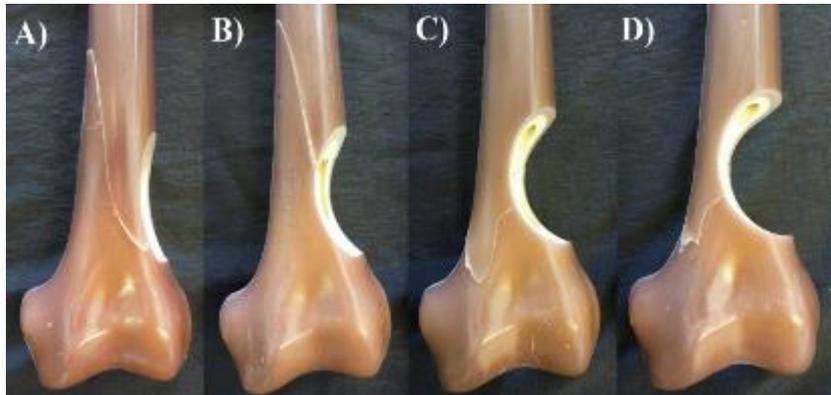
subjective
not evidence based
not FDA approved material



Torsional properties of distal femoral cortical defects.

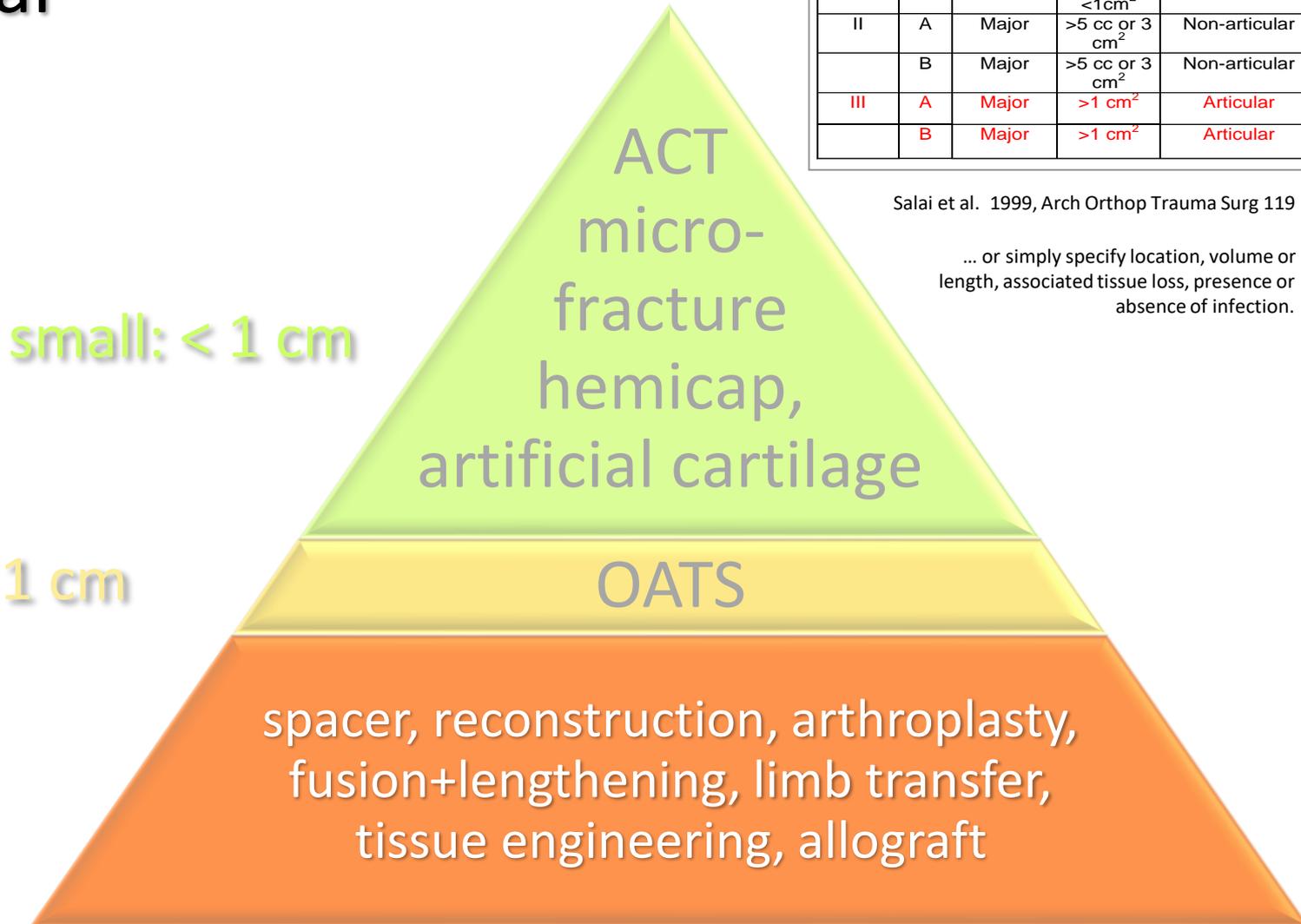
Amanatullah DF, Williams JC, Fyhrie DP, Tamurian RM.

- The larger the defect ... the greater the risk
- Critical loss of torsional integrity when a cortical defect approaches 50% of the width of the femur



Options for articular defects

mechanical
structural
biological



Definition

Type		Defect	Size	Articular
I	A	Minor	<1cc or <1cm ²	Either
	B	Minor	<1cc or <1cm ²	Either
II	A	Major	>5 cc or 3 cm ²	Non-articular
	B	Major	>5 cc or 3 cm ²	Non-articular
III	A	Major	>1 cm ²	Articular
	B	Major	>1 cm ²	Articular

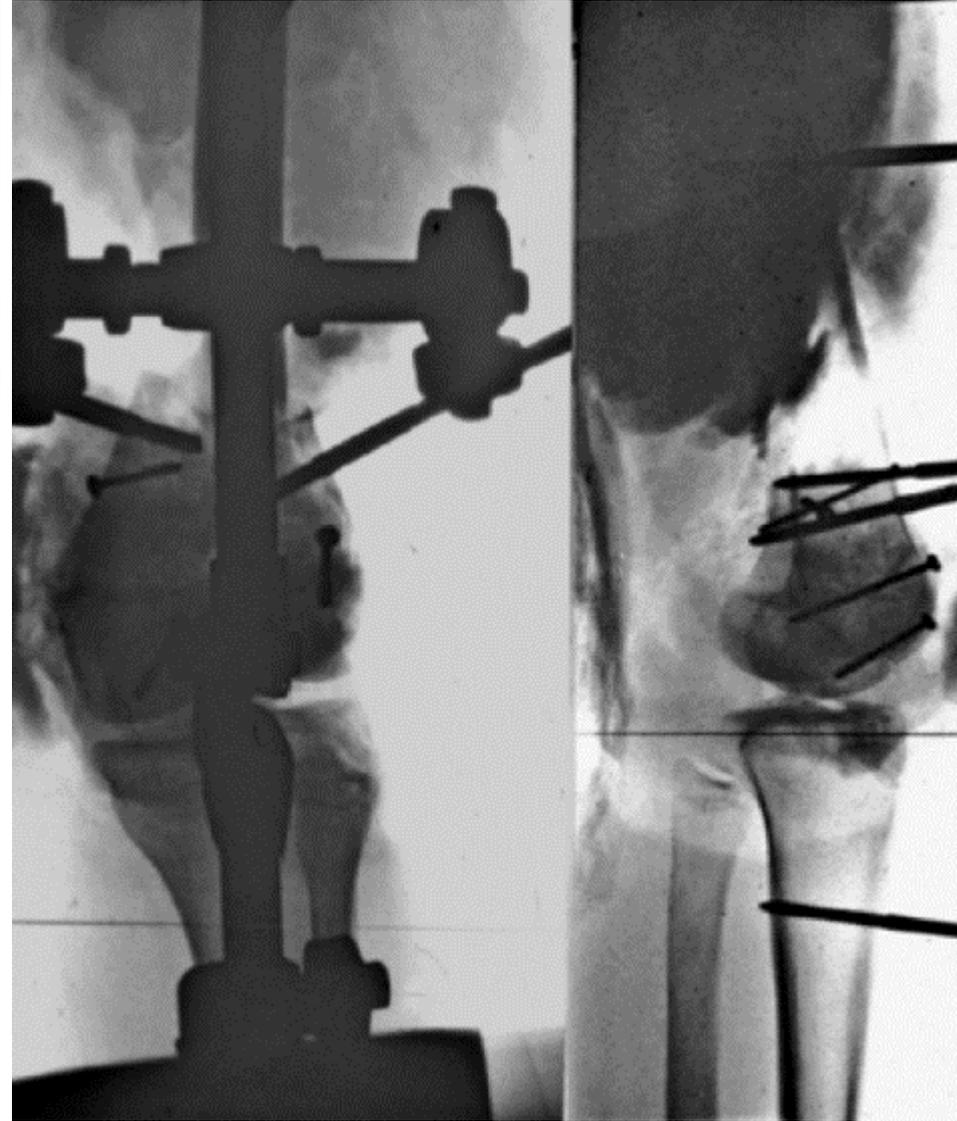
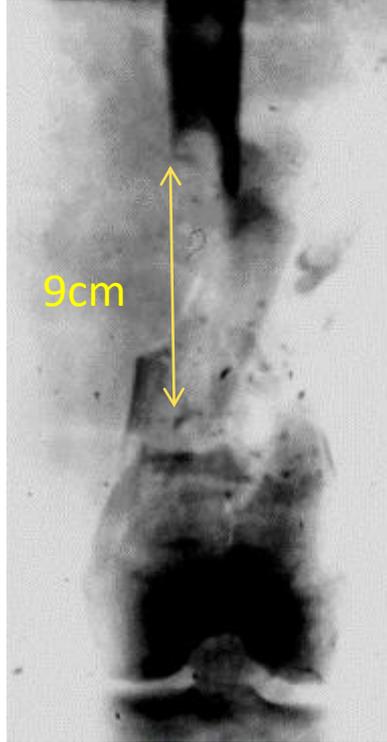
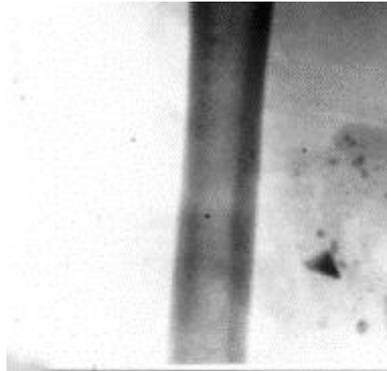
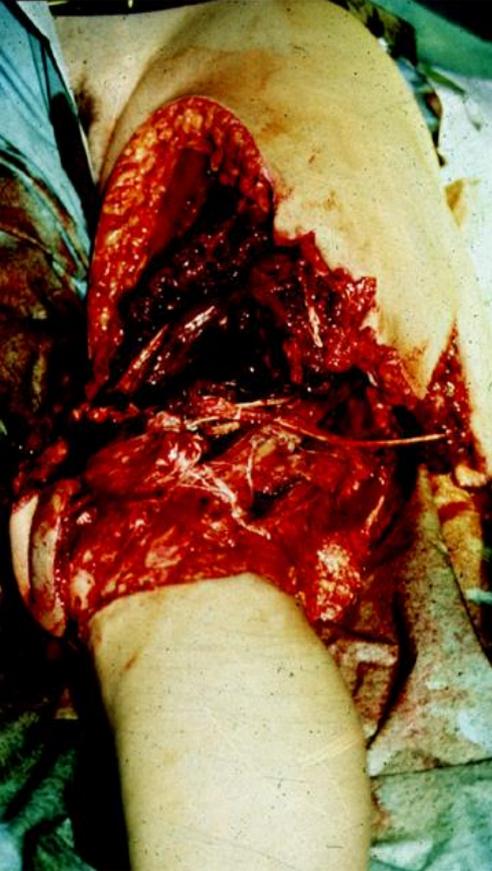
Salai et al. 1999, Arch Orthop Trauma Surg 119

... or simply specify location, volume or length, associated tissue loss, presence or absence of infection.



1. Metaphyseal Bone Defect DF

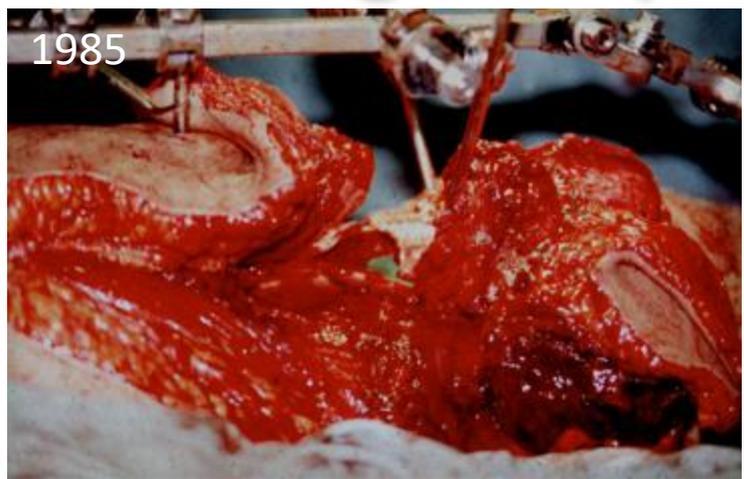
debridement, ORIF condyles, primary shortening



1. Metaphyseal Bone Defect DF

Bone graft (auto)

early secondary lengthening, bone graft, plate+ free flap



1. Metaphyseal Bone Defect DF

Bone graft (auto)

FU 2015 (30 years)

VAS 0

SF 36 Summary physical health 56 (51)

Summary mental health 58 (51)

WOMAC 2/100 (Best 0)

Lysholm 91/100 (Best 100)



1. Metaphyseal Bone Defect DF

Bone graft (auto)

FU 2015 (30 years)

50° active extension gap

ROM F/E 0/0/90

VAS 0

walking unlimited

SF 36 Summary physical health 56 (51)

Summary mental health 58 (51)

WOMAC 2/100 (Best 0)

Lysholm 91/100 (Best 100)



1. Metaphyseal Bone Defect DF

16 cm contaminated shaft, unperfused, periosteal stripping, 14 cm resected

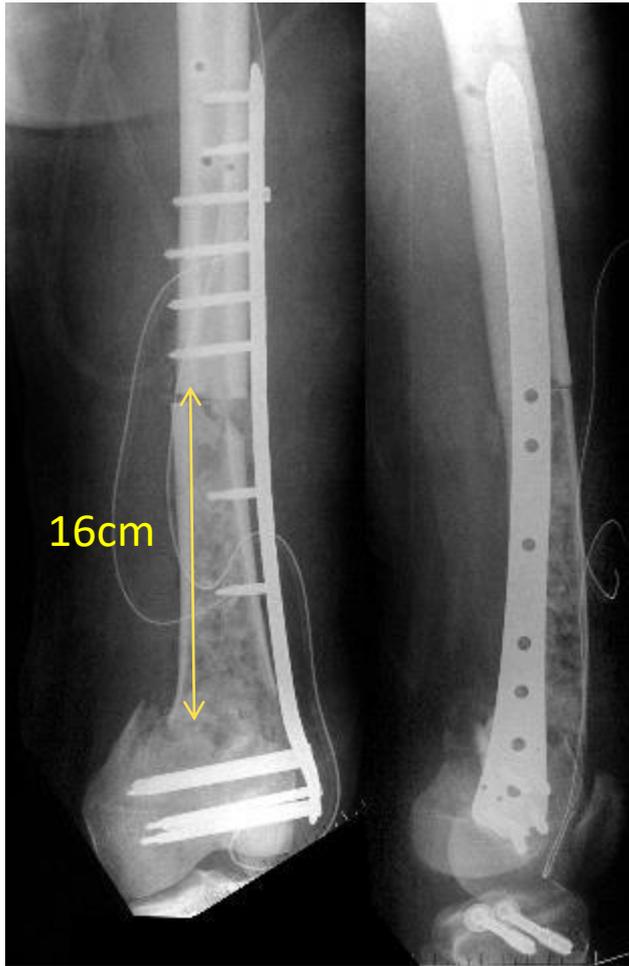


1. Metaphyseal Bone Defect DF

Bone graft (allograft)

2.7.2003 allograft

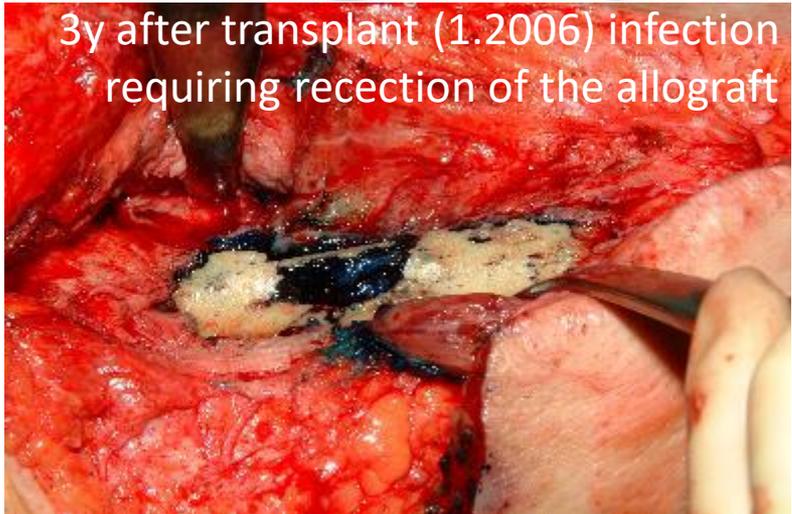
non-union, 2004 massive bonegraft



1. Metaphyseal Bone Defect DF

Bone graft (allograft)

debridement, segmental transport along plate w persistent infection



1. Metaphyseal Bone Defect DF

Bone graft (allograft)



FU 2015, 12 y
VAS 2
SF 36 phys health 49 (54)
 ment health 54 (51)
WOMAC 19/100 (Best 0)
Lysholm 49/100 (Best 100)



Reconstruction of Large Traumatic Segmental Defects of the Femur Using Segmental Allograft with Vascularized Fibula Inlay

Hyder Ridha, M.R.C.S.,¹ Jason Bernard, F.R.C.S.,² David Gateley, F.R.C.S.,¹
and Martin J. Vesely, F.R.C.S.¹

JOURNAL OF RECONSTRUCTIVE MICROSURGERY/VOLUME 27, NUMBER 6 2011

- The Capanna technique of reconstruction **combining allograft with vascularized bone graft** provides such a construct and has been described for oncological resection.
- **Three** reconstructions were performed for distal femoral segmental loss following trauma.
- Bone defects measuring **11, 9, and 8 cm** were reconstructed using a large segmental allograft and **free fibular flap inlay** assembly.
- **2y FU**
- Patients made uneventful recoveries and achieved full weight-bearing without walking aids 6 months post reconstruction.



1. Metaphyseal Bone Defect DF

Shortening

59 y polytraumatized, O3B 33C3



primary shortening 11cm (resection+impaction)
plan: lengthening after complete fx healing



1. Metaphyseal Bone Defect DF

Segmental transport after shortening

59 y polytraumatized, O3B 33C3
7.5cm lengthening w lengthening nail+HTO,
3.5cm left



FU 2015, 4 years

VAS 3

SF 36 phys health 40 (45)

mental health 24 (53)

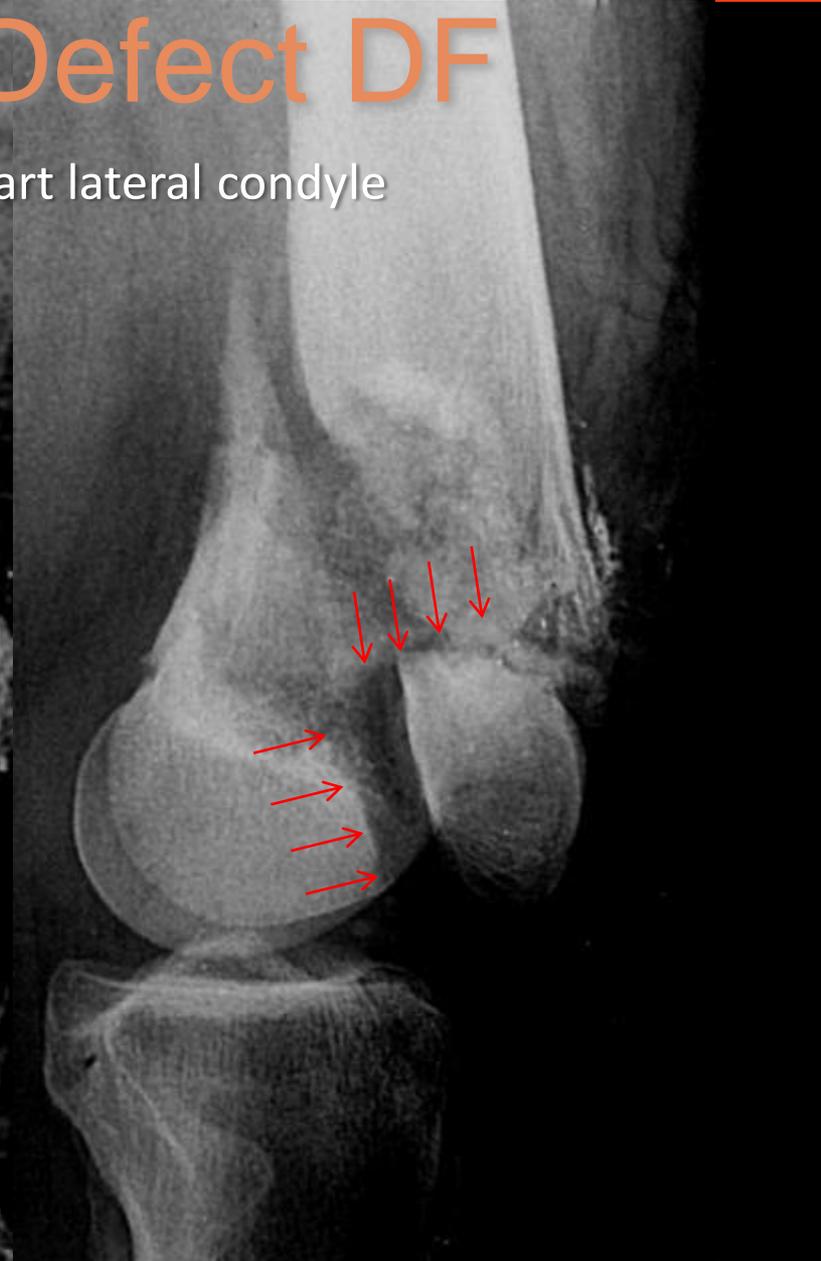
WOMAC 24/100 (best 0)

Lysholm 65/100 (best 100)



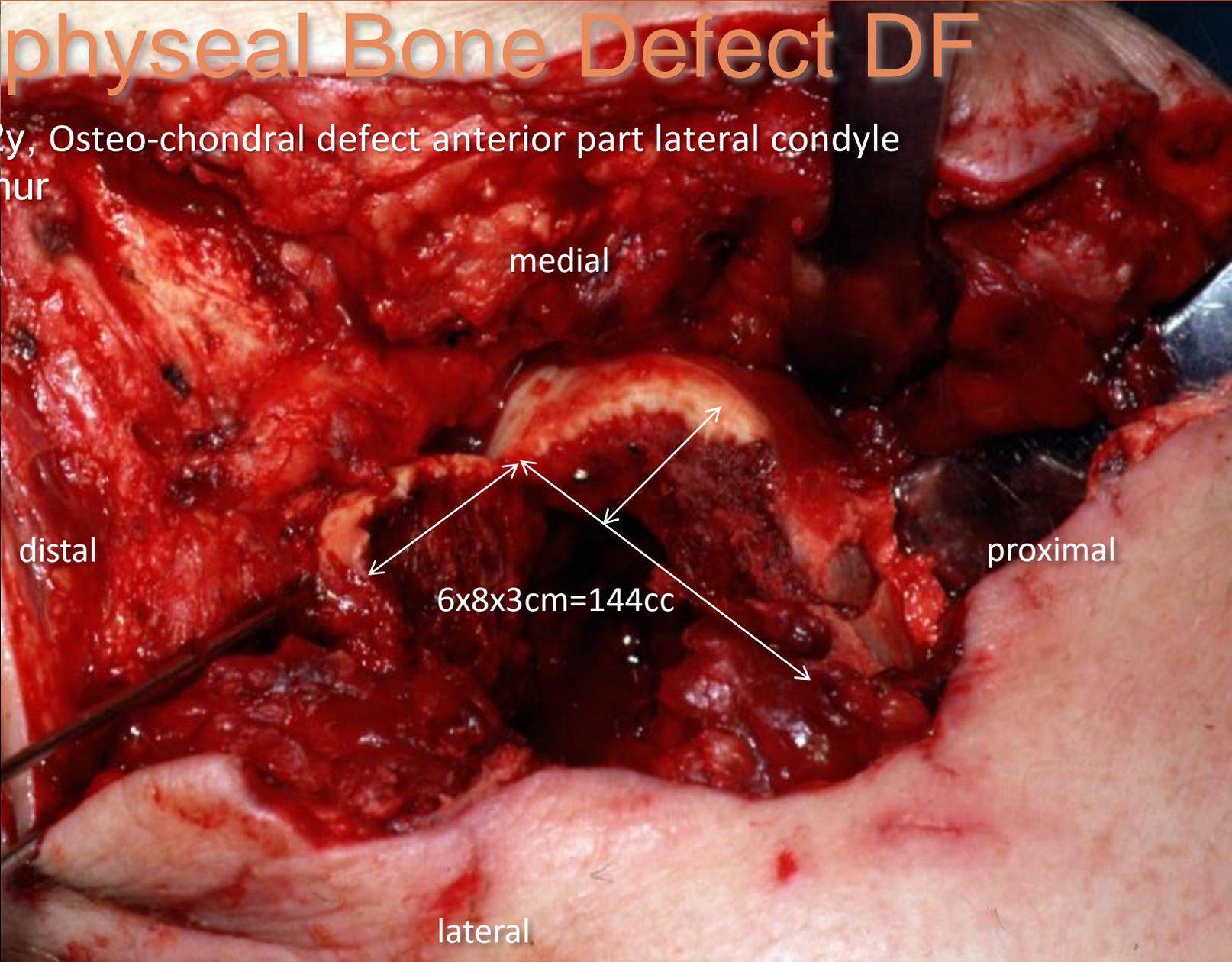
2. Epiphyseal Bone Defect DF

Werner J, 62y, Osteo-chondral defect anterior part lateral condyle left distal femur



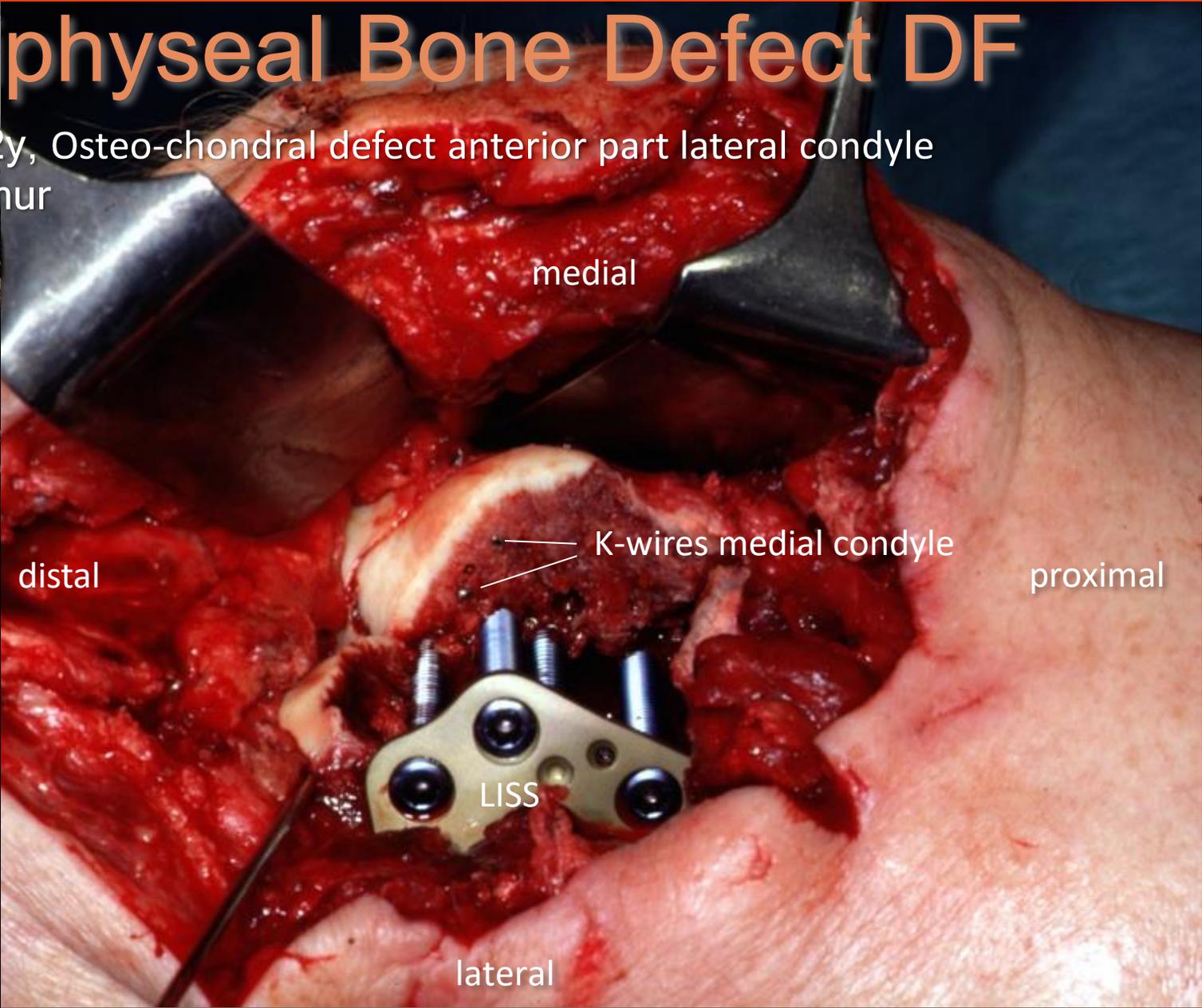
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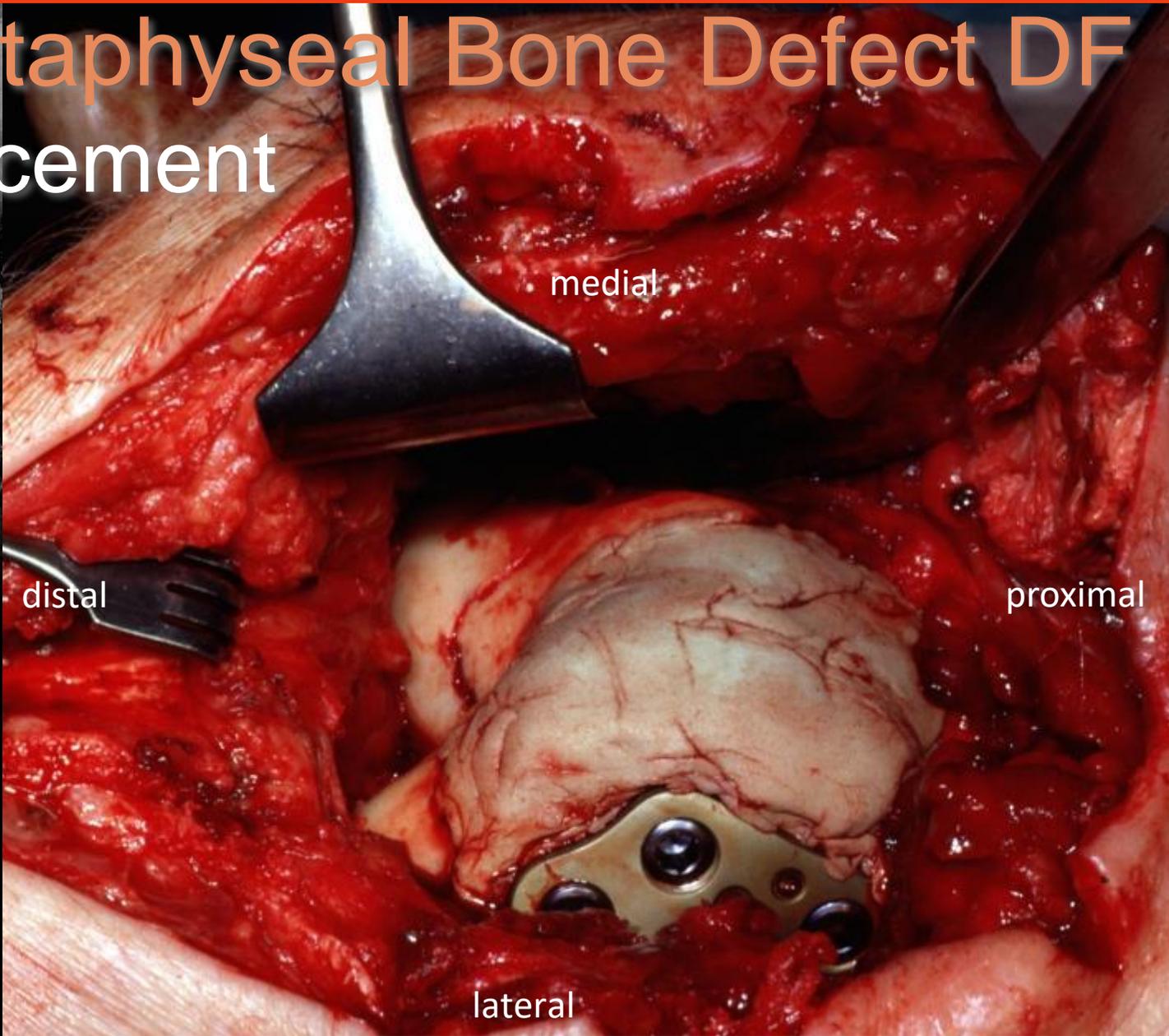
2. Epiphyseal Bone Defect DF

Werner J, 62y, Osteo-chondral defect anterior part lateral condyle left distal femur



2. Metaphyseal Bone Defect DF

Bone cement



2. Epiphyseal Bone Defect DF

Bone cement

2007 9y after trauma now
73y old



2. Epiphyseal Bone Defect DF

Bone cement

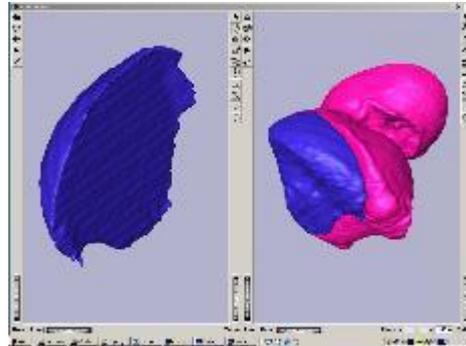


FU 2015, 17 years
VAS 2
SF 36 physical 42 (40)
 mental 32 (52)
WOMAC 32/100 (best 0)
Lysholm 74/100 (best 100)



2. Epiphyseal Bone Defect DF

26y, posttraumatic defect tibia & femur, med. coll. lig. instability



analog copy milling for a key



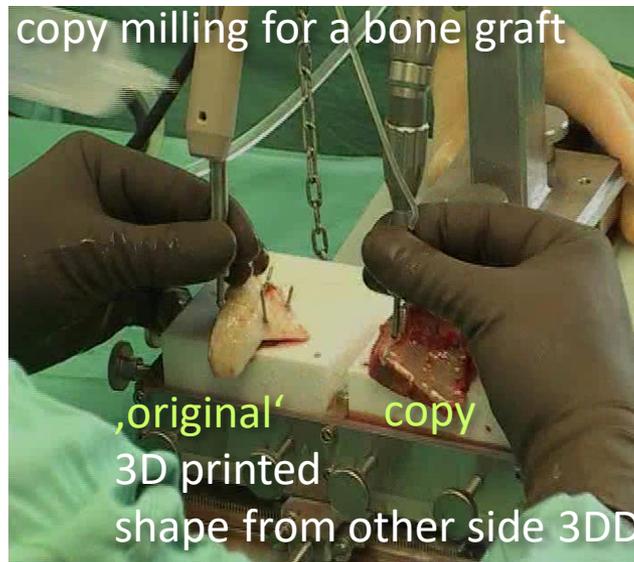
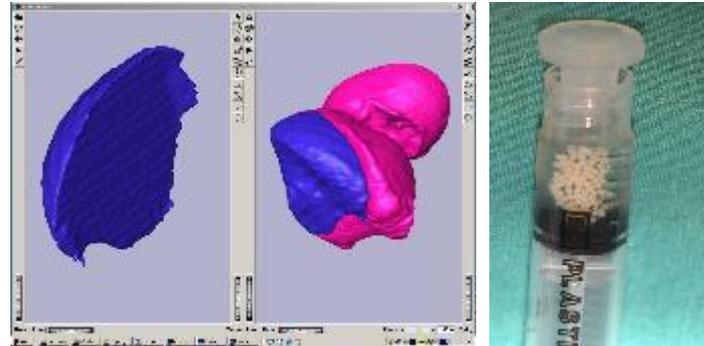
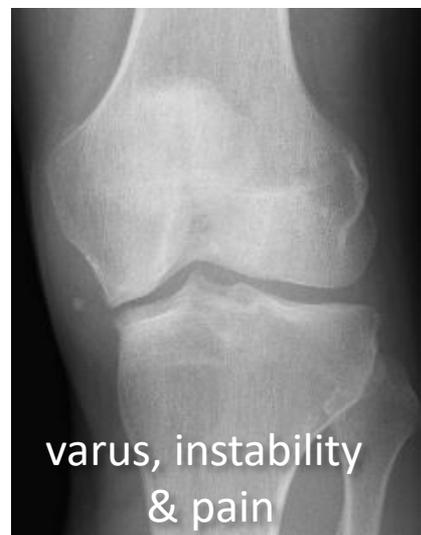
plan:
3D print copied
into a bone graft



2. Epiphyseal Bone Defect DF

Structured autograft + cultured cartilage

26y, posttraumatic defect tibia & femur, med. coll. lig. instability

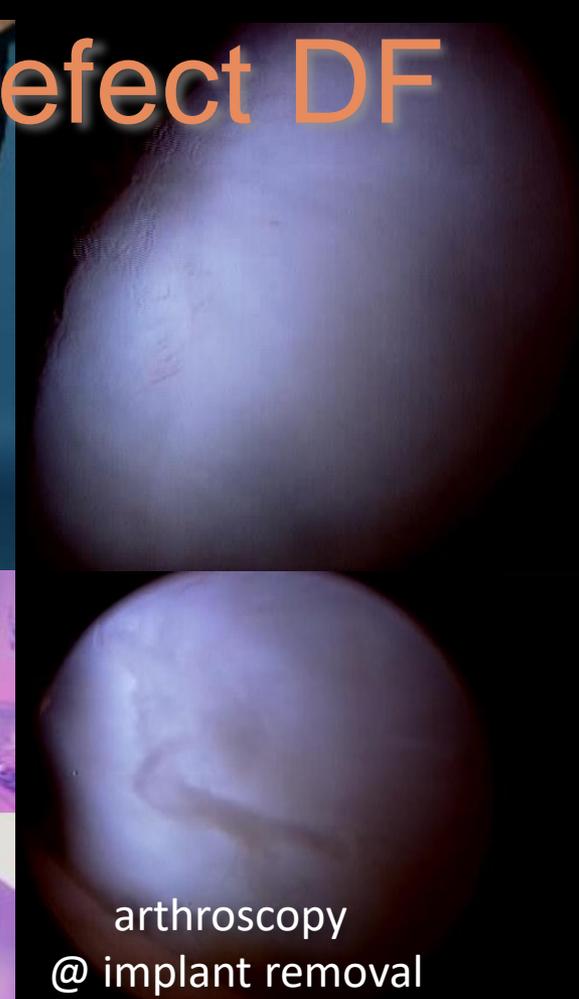


2. Epiphyseal Bone Defect DF

Structured autograft + cultured cartilage



histology from repair site



arthroscopy
@ implant removal



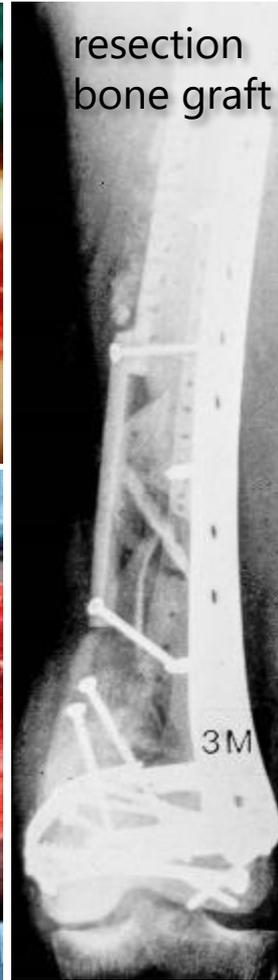
FU 2015, 7 years
VAS 0
SF 36 physical health 55 (54)
 mental health 59 (51)
WOMAC 9/100 (best 0)
Lysholm 85/100 (best 100)

3. Epi- & metaphyseal Bone Defect DF

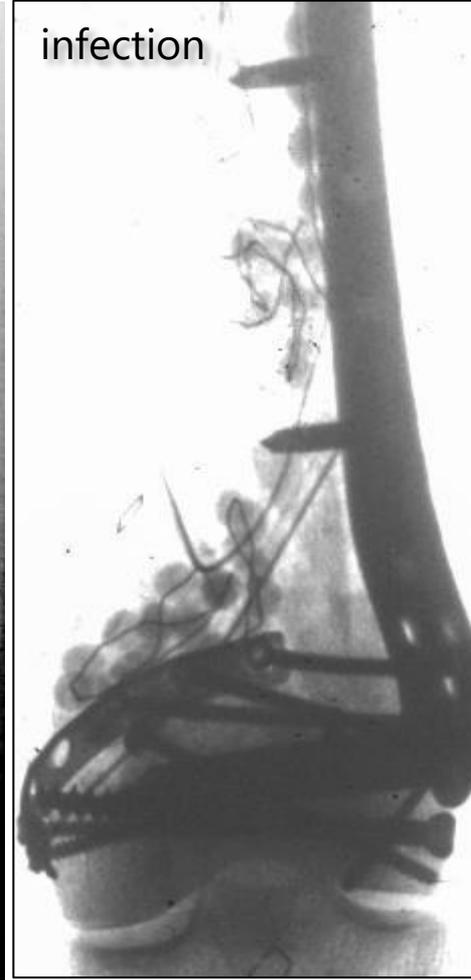
30y motorcycle
33C3 / O3B



resection
bone graft

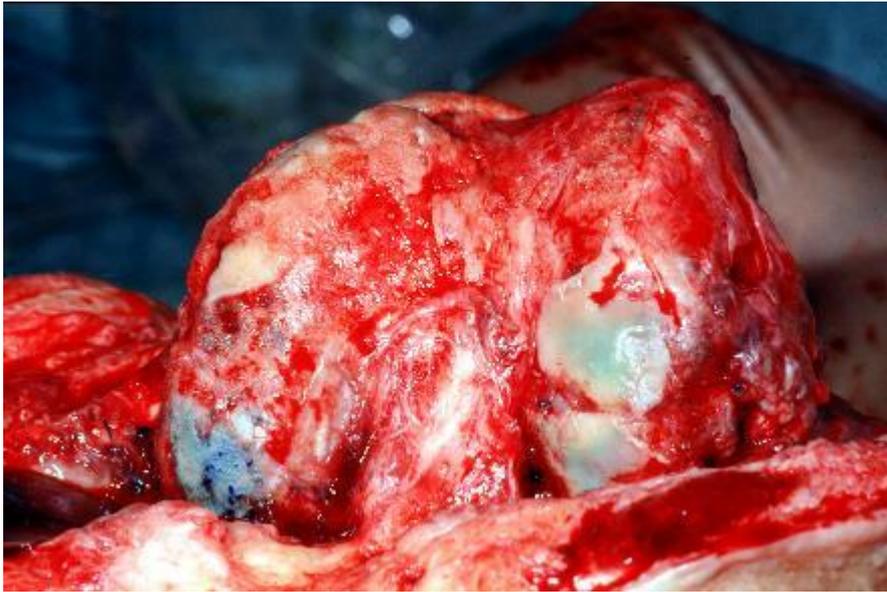


infection



3. Epi- & metaphyseal Bone Defect DF

24cm defect



3. Epi- & metaphyseal Bone Defect DF Arthroplasty

tumor prosthesis
...
9m later re-infection
2 stage revision



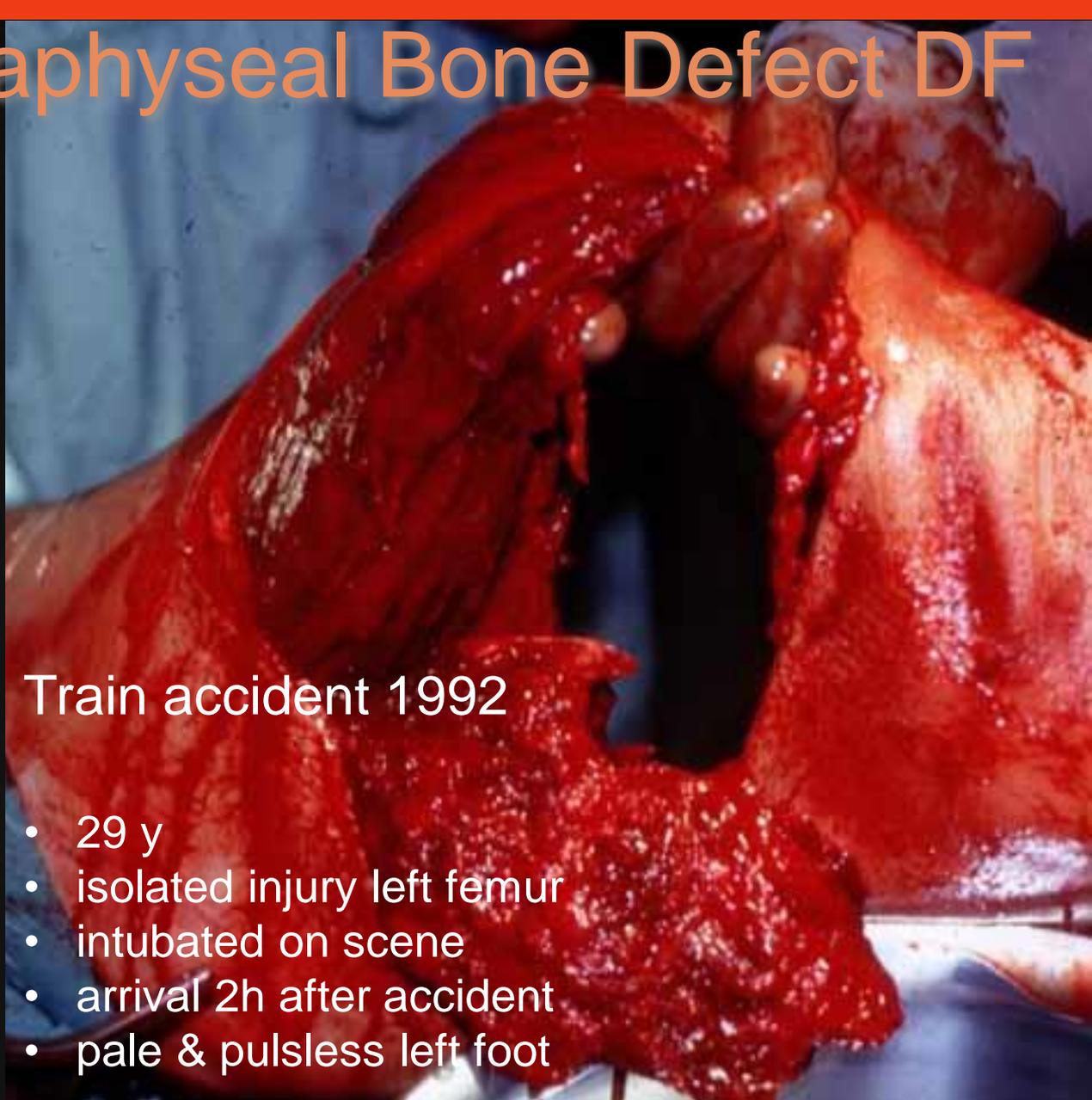
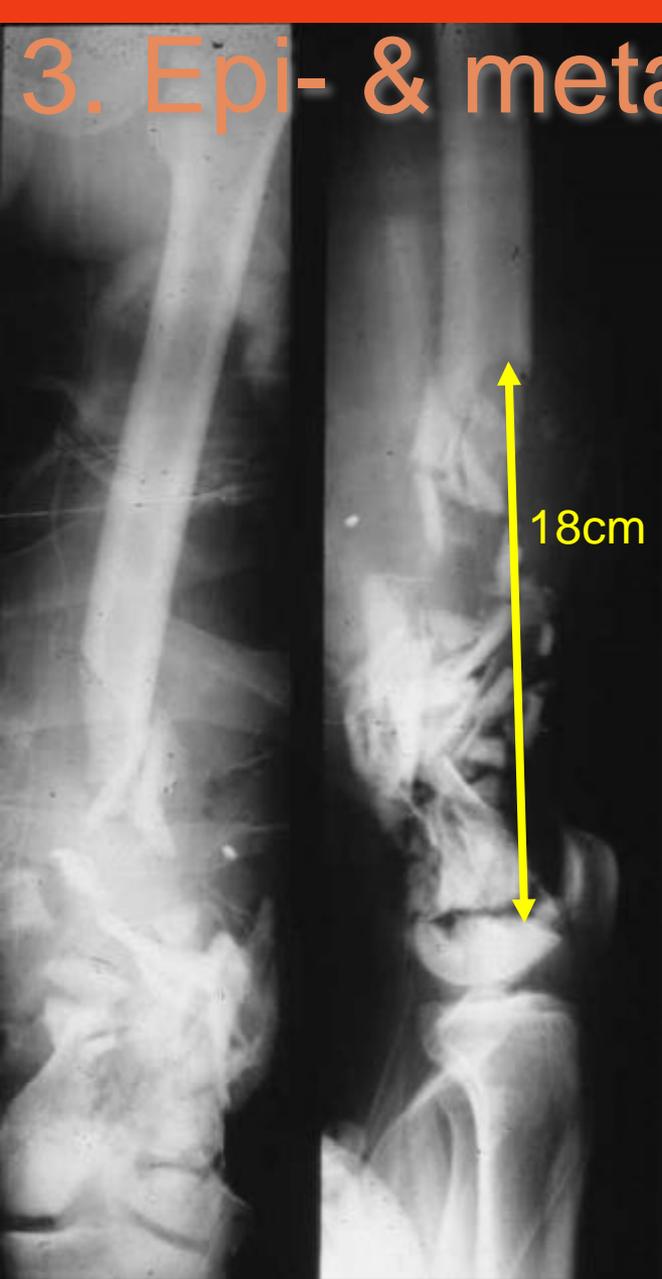
FU 2015, 18 years
VAS 4
SF 36 physical health 39 (51)
 mental health 36 (51)

WOMAC 70/100 (best 0)
Lysholm 45/100 (best 100)

chronic pain patient

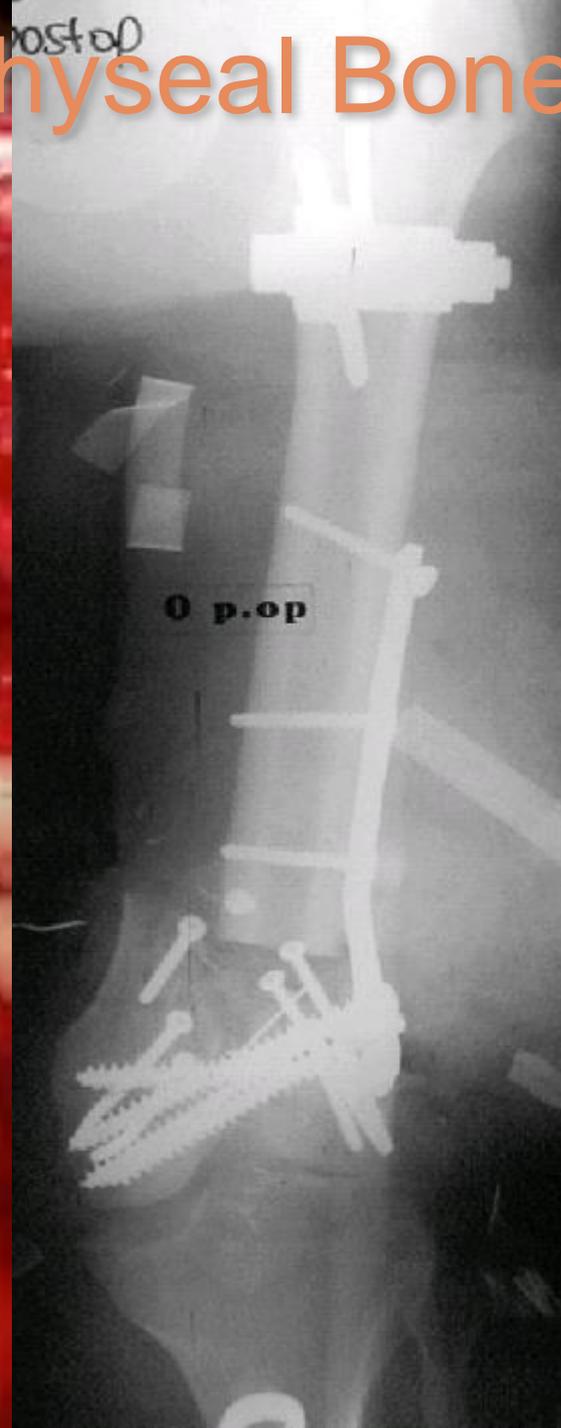


3. Epi- & metaphyseal Bone Defect DF

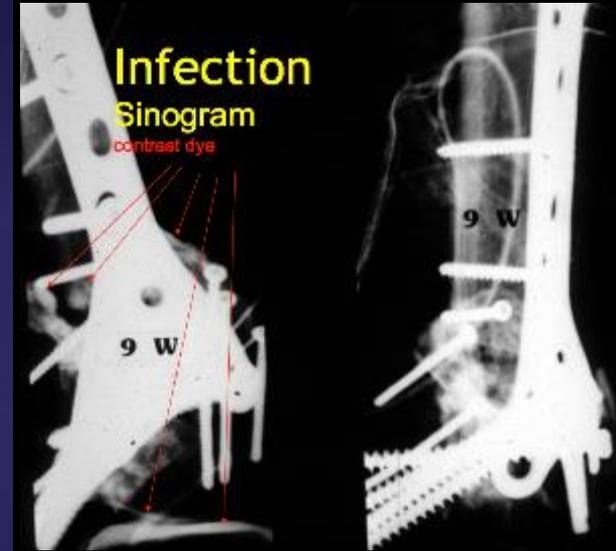


3. Epi- & metaphyseal Bone Defect DF

vascular repair
fasciotomy
condylar reconstruction
shortening 18 cm
bridging external fixation



3. Epi- & metaphyseal Bone Defect DF



Decision matrix

possibilities	problems	time	expected complications	expected function	
joint preservation + lengthening	menisci congruency infection instability arthritis	18 M	++++	+	-
AK amputation	function	3 M	+	+	++
arthrodesis + lengthening	time	> 18 M	+++	++	+
arthrodesis	shortening 25 cm	6 M	++	+	+(+)
rotationplasty	weakness peroneal nerve	6 M	++	+++	+++



3. Epi- & metaphyseal Bone Defect DF

Rotationplasty

18 y follow up



3. Epi- & metaphyseal Bone Defect DF

Rotationplasty

18 y follow up



3. Epi- & metaphyseal Bone Defect DF

Rotationplasty

18 y follow up



3. Epi- & metaphyseal Bone Defect DF

Rotationplasty

18 y follow up

Huang CT et al. Amputation:
Energy cost of ambulation.
Arch Phys Med Rehab 1979

walking energy
compared to normal ...

BK amputation +09%

AK +49%

Rotationplasty similar to BK

Arch Orthop Trauma Surg (2013) 133:351–355
DOI 10.1007/s00402-012-1671-8

TRAUMA SURGERY

Eighteen-year follow-up after fracture of the distal femur

M. Petri · M. Omar · H. Horstmann ·
S. Brand · C. Krettek

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Rotationplasty for the Treatment of Severe Bone Loss and Infection of the Distal End of the Femur

A CASE REPORT*

BY CHRISTIAN KRETTEK, M.D., DAVID A. LEWIS, M.D., THEODORE MICLAU, M.D.,
PETER SCHANDELMAIER, M.D., PHILIPP LOBENHOFFER, M.D., AND
HARALD TSCHERNE, M.D., HANNOVER, GERMANY

Investigation performed at the Trauma Department, Hannover Medical School, Hannover



Summary Epi- & Metaphyseal Bone Defects DF

- few evidence for distal femoral defects
- 6 examples average 15y FU
- individualized treatment
- experience with bone, soft tissue, cartilage & arthroplasty

