

Extracorporeal high energy shock wave treatment (ESWT) for non-union and pseudarthrosis

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patients

1991-2001, n=151, 92 male, 59 female
age 14 – 83 years (mean 42,1)

humerus	5	femur	23	pelvis	1
radius	7	tibia	67		
ulna	8	fibula	7		
scaphoid	9	metatarsalia	22	clavicula	1
phalanx	1				
	30		119		2

history of the patients

- **13 % of the patients: no fracture healing after conservative treatment**
- **in 87 % previous unsuccessful surgical procedures (1 – 11, mean: 2,8 operations)**
- osteosynthesis material *in situ* (66,4%)
- reduced/absent usability of extremity
- pain/instability at fracture site
- period of unsuccessful treatment prior to ESWT (median): 11 months

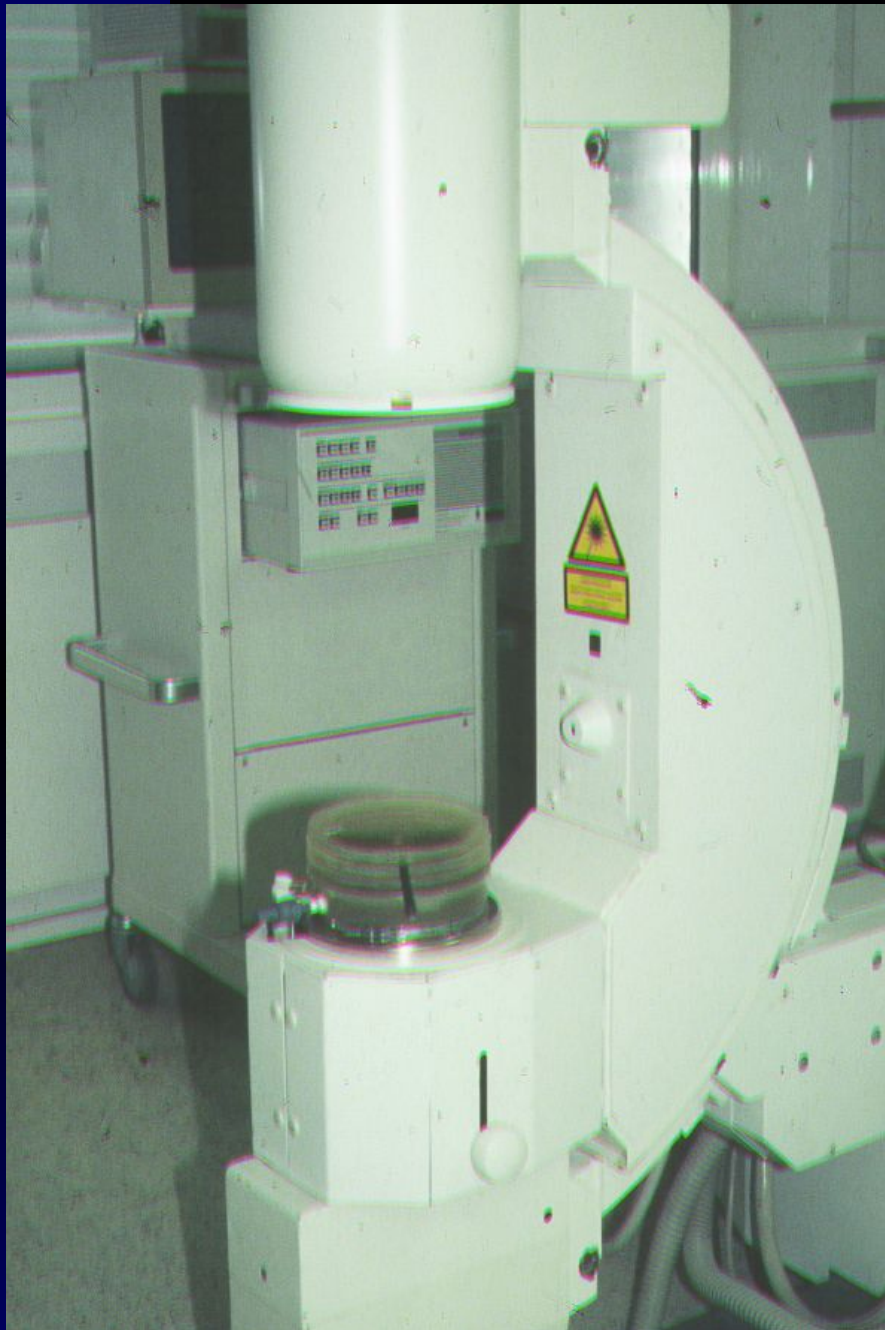
our indications for ESWT:

- **Non-union (pseudarthrosis) more than 6 months after fracture or surgery**
- hypertrophic (vital, reactive) pseudarthrosis
- atrophic (non reactive) pseudarthrosis with close contact of bone fragments (no greater defects)
- **exclusion of patients with soft tissue or bone infections, malignancies, pregnancy and hemorrhagic diathesis**

in all patients clinical evaluation, blood tests, x-ray, (CT-scan, scintiscan)

methods

- ESWT with SIEMENS-Osteostar
- 2000 – 8000 shock waves per session
(mean per patient: 11000 shock waves)
- energy densities 0,47 – 0,84 mJ/mm²
- stepwise series of shock waves according to localisation, size and shape of pseudarthrosis
- general or regional anesthesia
- maintainance of fracture stabilisation (osteosynthesis/cast) after ESWT
- clinical and x-ray controls (every 4 weeks)



early results

- duration of ESWT 0,5 – 2,5 hours
- no general reactions or disorders
- immediate pain reduction at the site of pseudarthrosis in many cases
- rarely (17 %) local hematoma, edema or petechiae
- 1 patient (0,7 %) with chronic osteitis developed deep hematoma and abscess

in cases with insufficient union:

repetition of ESWT (1-3 sessions, mean 1,2)

long term results

(follow up 6 – 84 months, mean: 30,2)

	patients	union	%
pelvis	1	1	
femur	23	16	69
tibia	65	50	77
fibula	7	5	71
metatarsalia	19	17	89
clavicula	1	1	
humerus	3	2	
radius/ulna	15	7	47
phalanx	1	-	
scaphoid	8	2	25
<i>total</i>	<i>143</i>	<i>101</i>	<i>70,6</i>



2° open tibia fracture

(osteitis, 5 operations)

30 months after trauma



union after ESWT (2x)

1° open fracture

UTN

14 months

post op

2 x ESWT

after ME



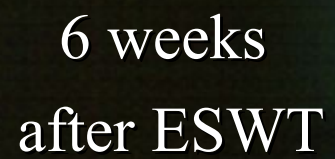


R

tibia fracture

(2 operations)

after 11 months: non-union



R

6 weeks
after ESWT

2° open tibia fracture:
non-union after 3 operations
(18 months after trauma)



tibia fracture

non-union 8 months after surgery

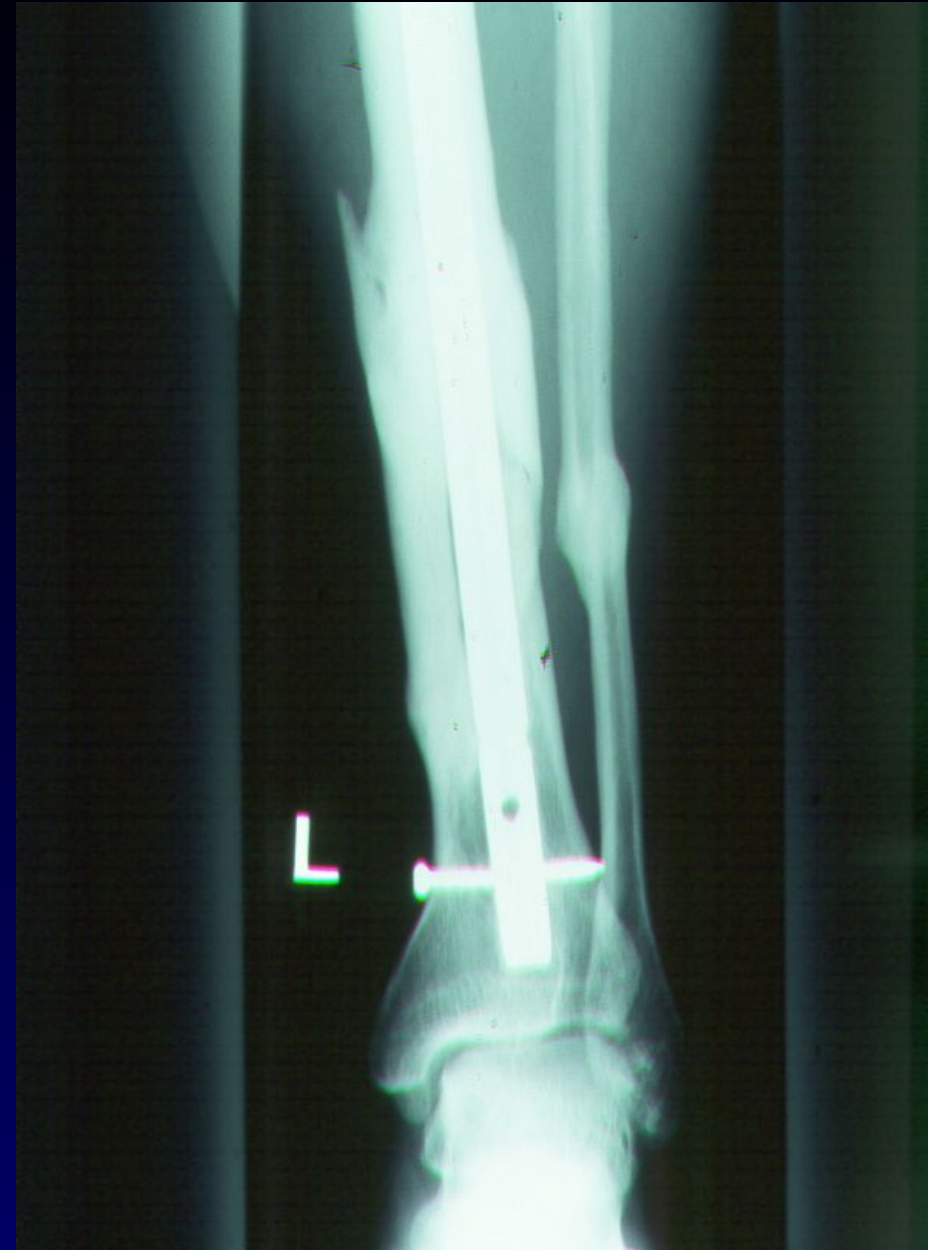
after ESWT (1x)



1° open
tibia fracture
9 months
after surgery)



after ESWT (2x)

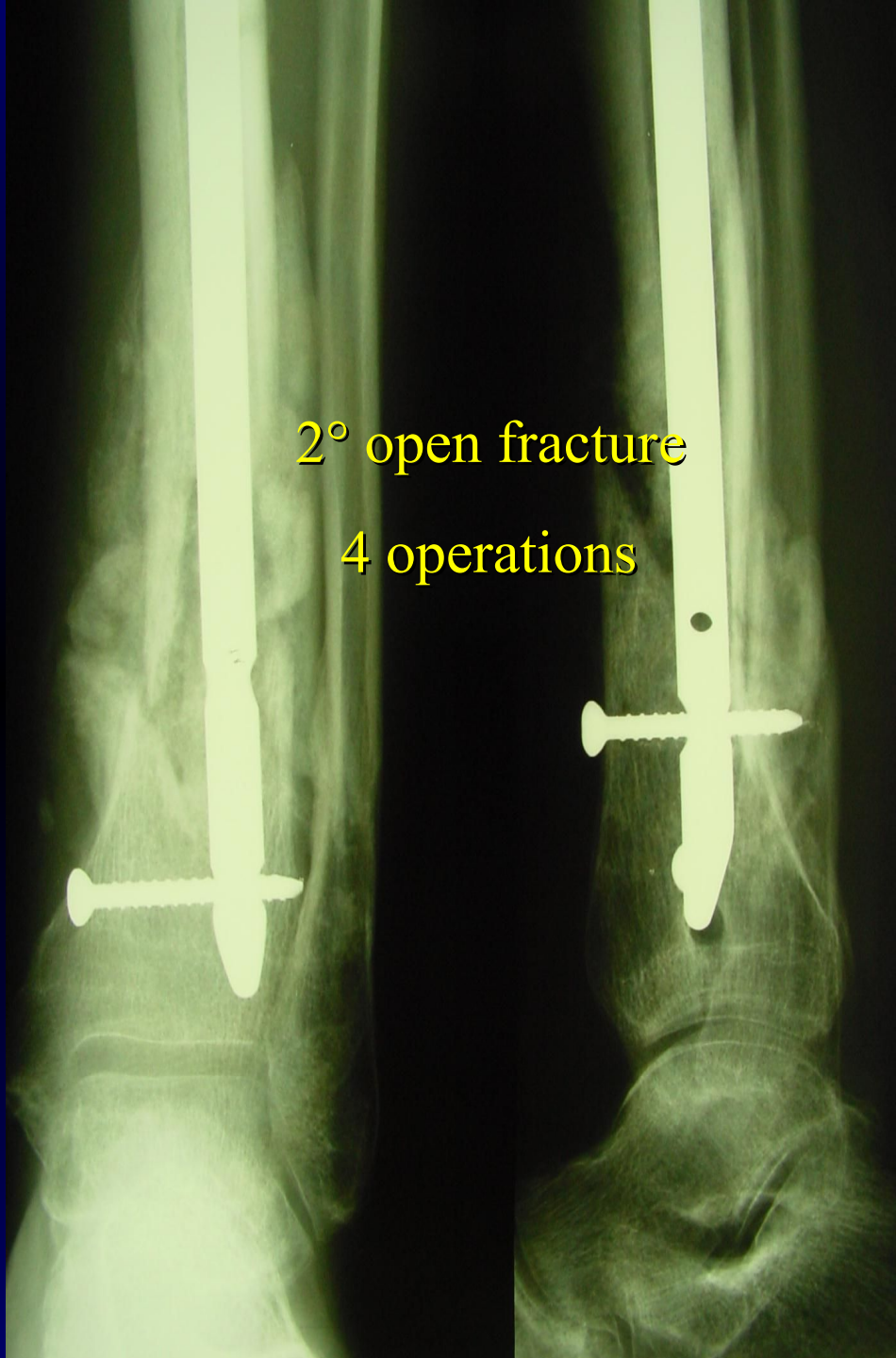


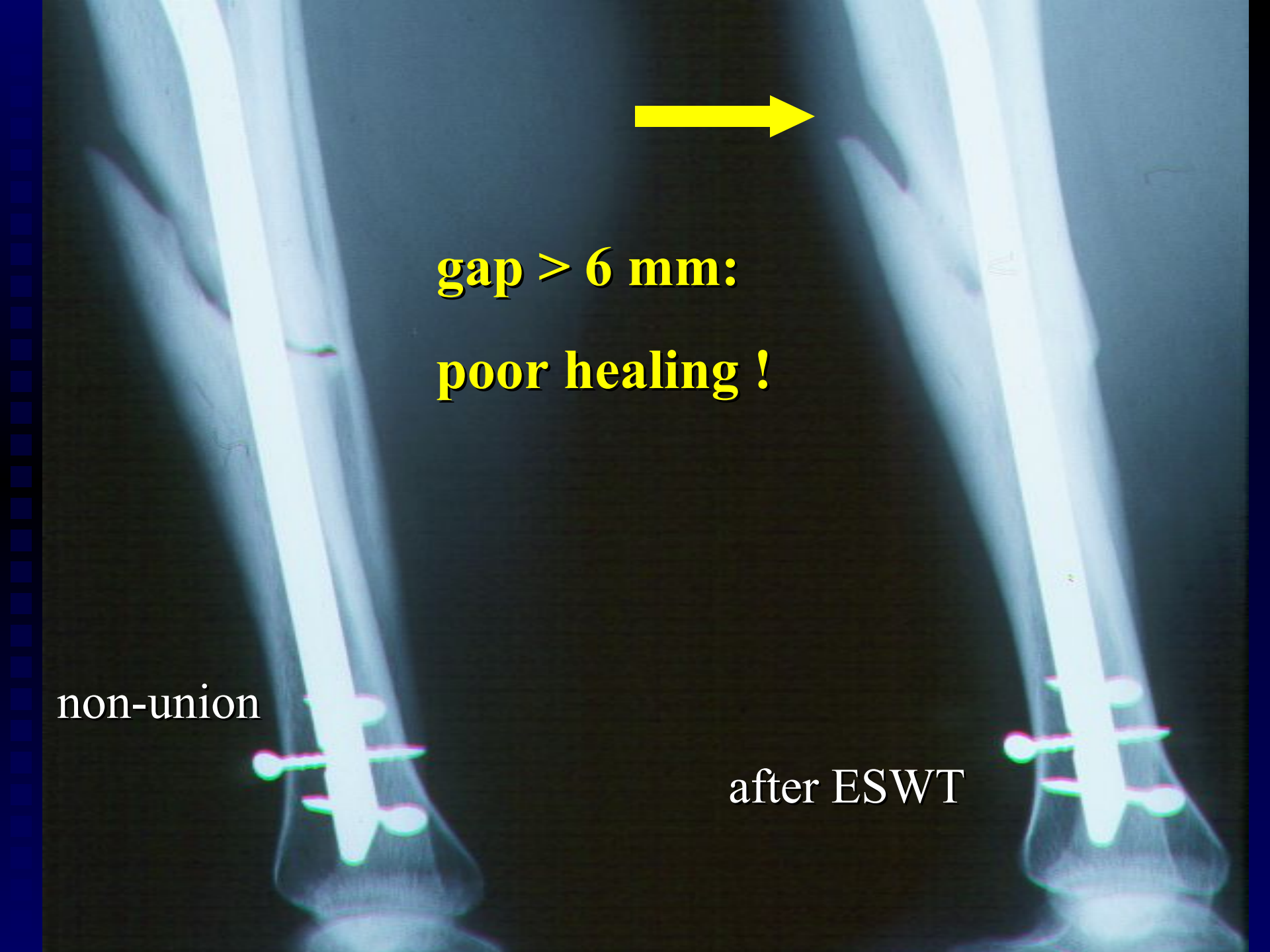
2° open fracture

4 operations

6 months after

2 x ESWT





**gap > 6 mm:
poor healing !**

non-union

after ESWT

tibia pseudarthrosis

- **our largest and clinically most important group of patients**
- mostly immobilized/invalid patients
- multiple (1 – 11) unsuccessful previous operations in 61 patients (94 %)
- non-union for 6 – 50 months (mean 28,5)

tibia pseudarthrosis after ESWT

long term results (mean follow up 30,2 months)

	patients	union	%
atrophic	37	22	59
hypertrophic	28	28	100
total	65	50	77

fracture location (proximal, shaft, distal):
no significant difference for union !

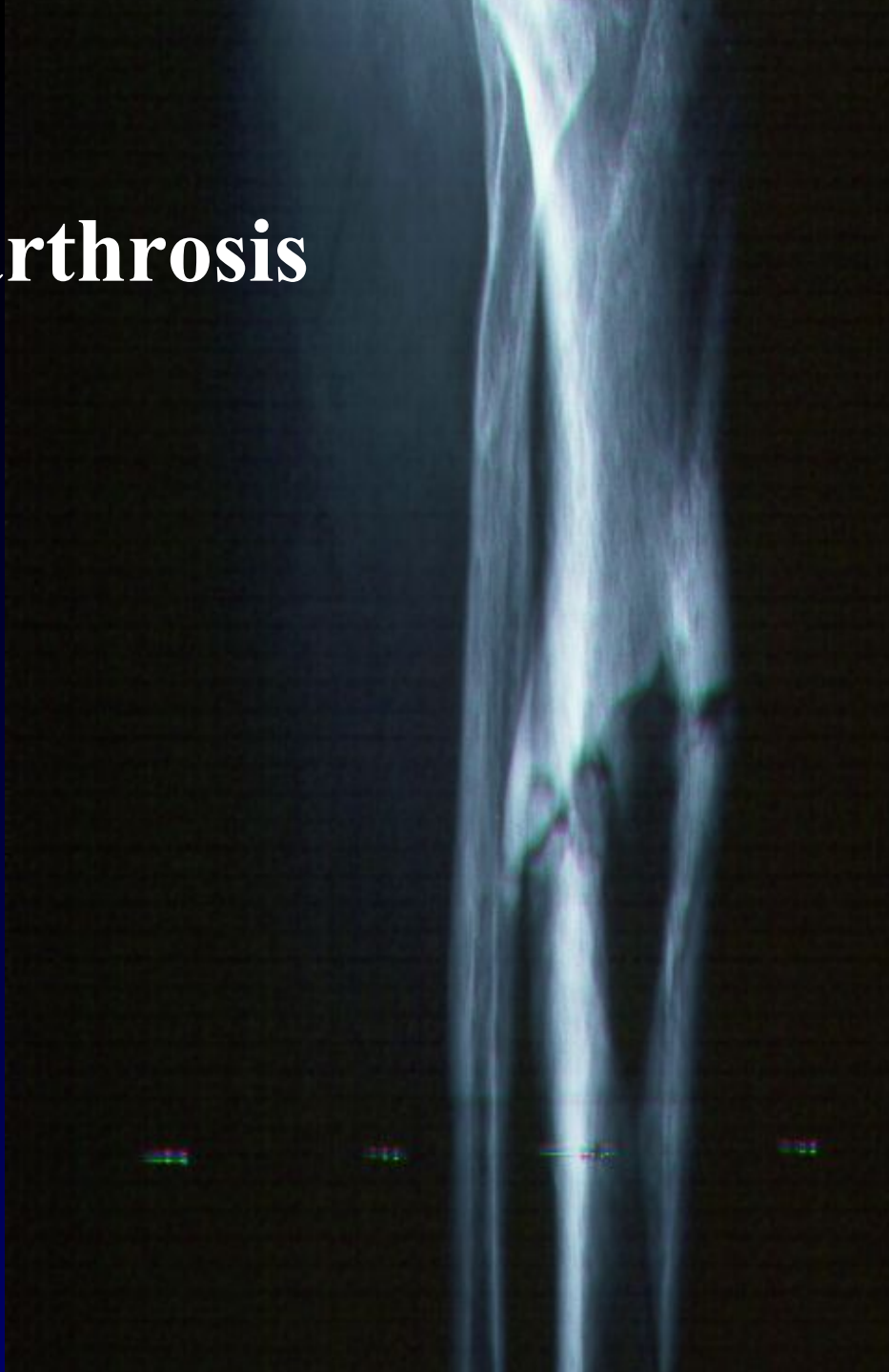
- no refracture after ESWT-union

problem:
defect pseudarthrosis

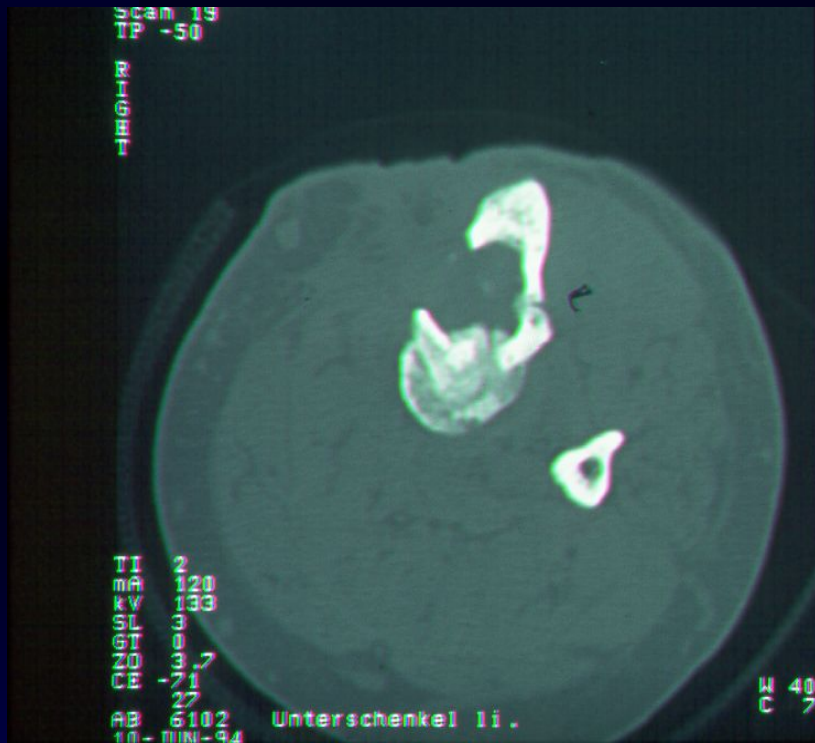
tibia fracture
(48 years), female

5 operations,
osteitis,
defect pseudarthrosis,
pain, instability,

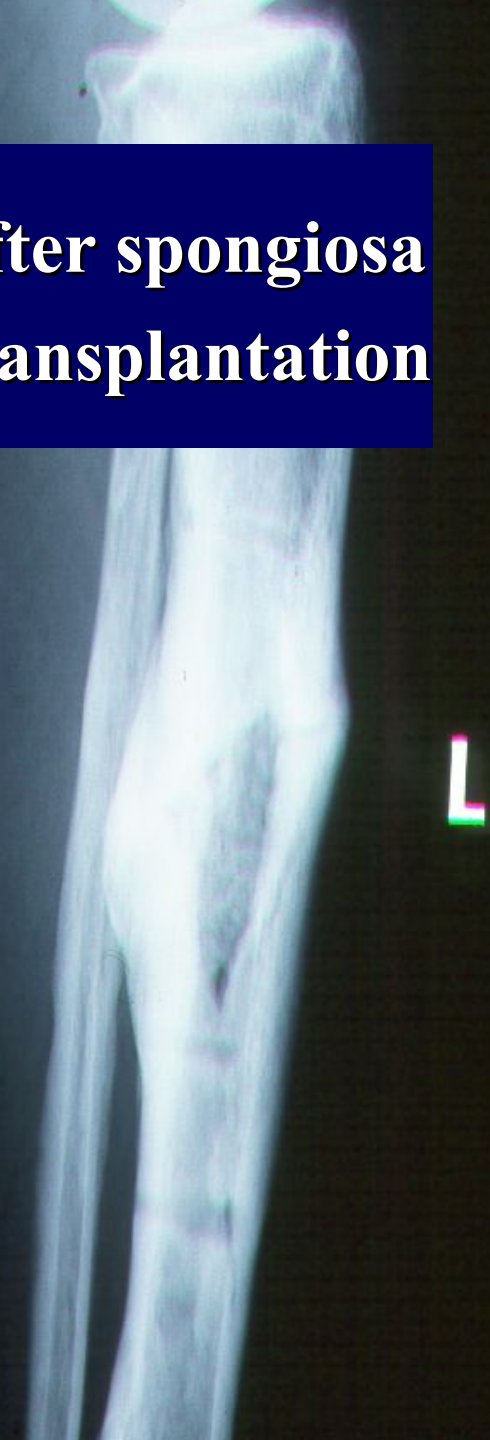
history prior to ESWT:
49 months



ESWT alone



**after spongiosa
transplantation**



persistent
non-union

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after
spongiosa
transplantation

after
ESWT (2x)



defect pseudarthrosis:

- no healing with ESWT alone
- combination of ESWT and autologous spongiosa transplantation causes fracture union even in „hopeless“ cases

ESWT: conclusions

- **92 % fracture healing for hypertrophic pseudarthrosis**
- **72 % fracture healing for atrophic pseudarthrosis with close contact of bone fragments**
- **very low union rates for atrophic pseudarthroses with greater bone defects**

ESWT: conclusions

- good union rates for fibula, tibia and metatarsalia (71 % – 89 %)
- lower union rates for scaphoid and the forearm (25 % - 47 %)
- **persistent non-union after ESWT even not curable with conventional surgery in many cases**