



The mangled extremity – amputation or reconstruction?

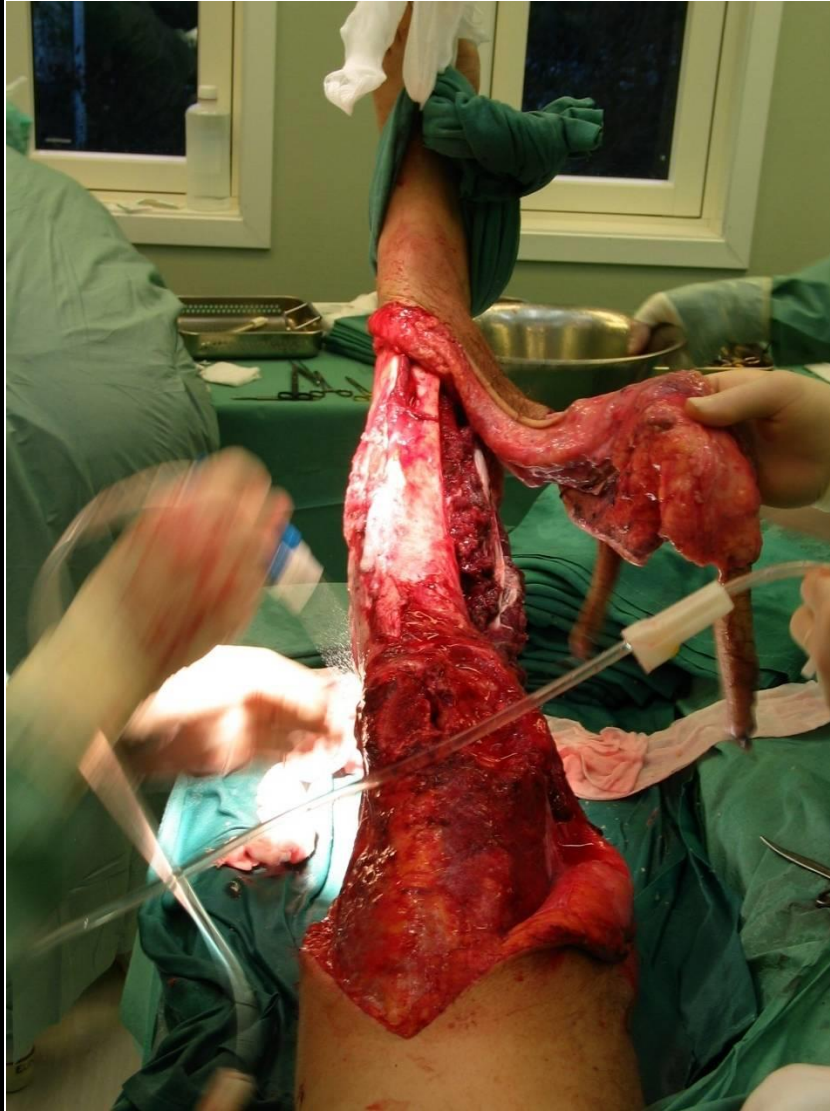
AO trauma course

Advanced principles of fracture management

7-9/4-2025

Jeppe Barckman

Amputation or reconstruction?

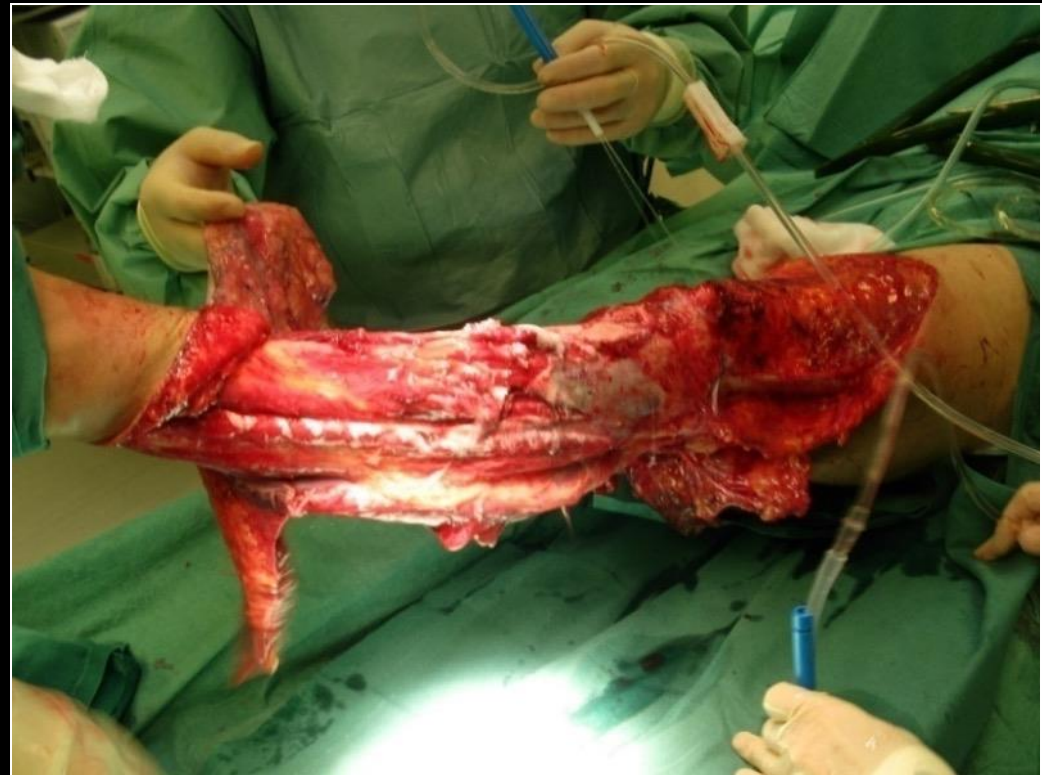


Mangled extremity

Definition

A limb with an injury to at least three out of four systems:

- Soft tissue
- Bone
- Nerves
- Vessels



Mangled extremity

Etiology

- Motor vehicle accidents
- Industrial/farm accidents
- Fall from height



High energy trauma

- Explosion
- Blast injuries sustained in military



Mangled extremity

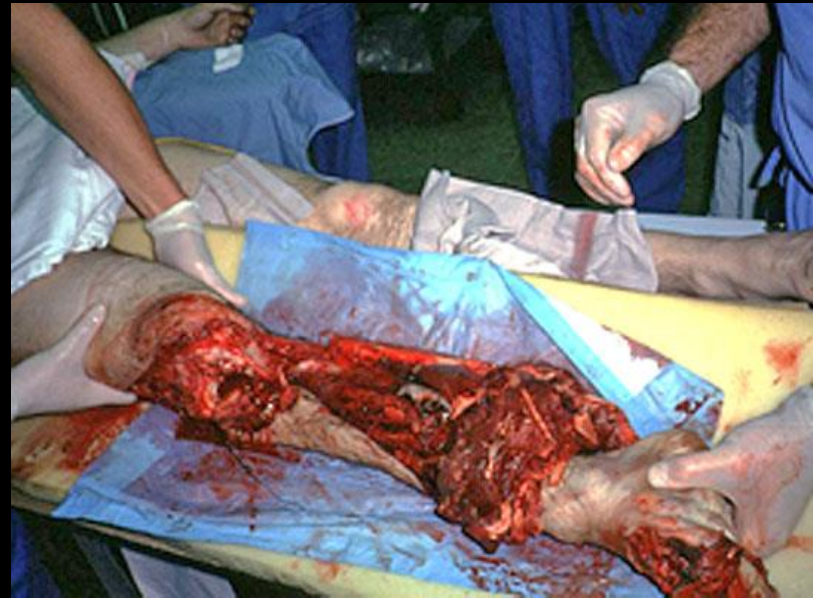
Initial management

Life before limb

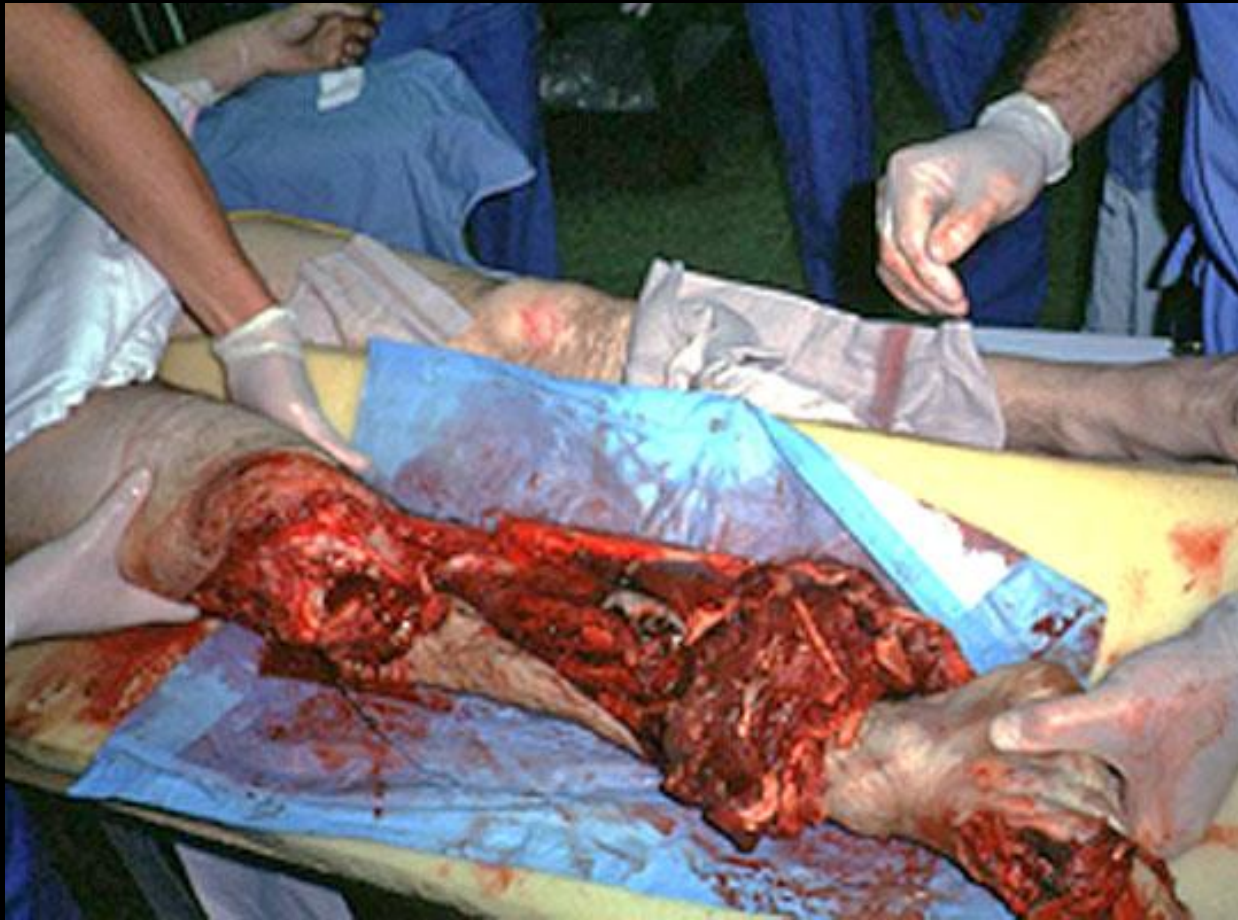
10-50% have associated life-threatening injury

- Bosse MJ, MacKenzie EJ, Kellam JF, et al. (2002).
- Caudle RJ. *J Bone Joint Surg Am.* 1987

ATLS protocol



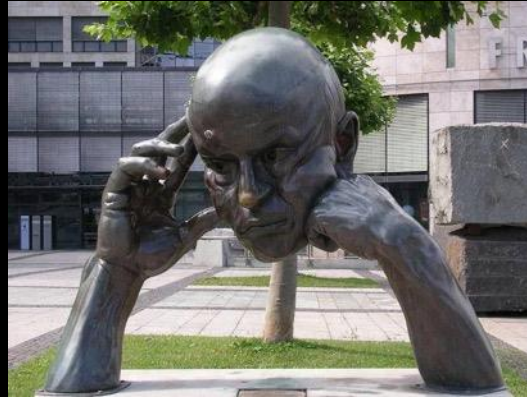
orthopedic treatment in the ER



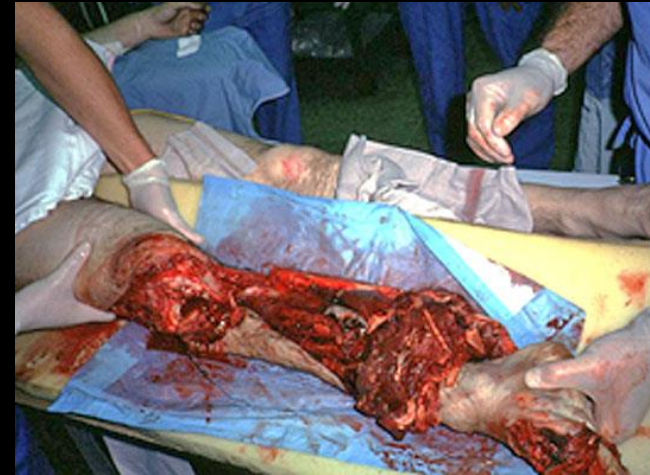
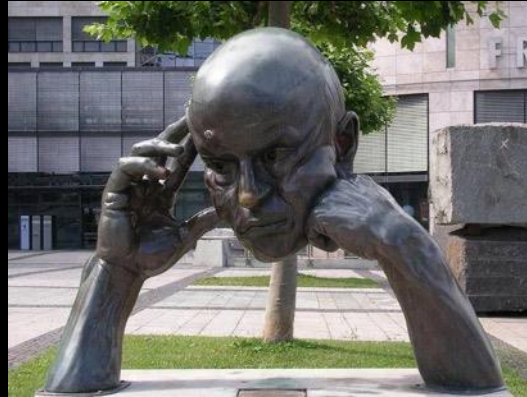
orthopedic treatment in the ER

1. Antibiotic and Tetanus prophylaxis
 - 1. generation Cephalosporin + Gentamicin
2. Reduction of fracture/joint dislocation
 - motor-, sensory and perfusion examination is repeated after reduction
3. Removal of any gross contamination and gently irrigation
4. Immobilize the extremity
 - splint or cast
5. Apply sterile dressing

then what?



Plan?



Acute amputation (< 24h)?

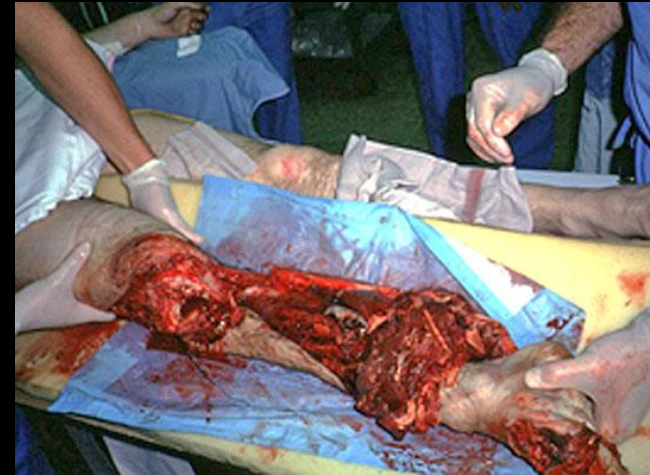


Acute amputation

indications

- **Absolute criteria:**

- Ischemia time > 6 hours lower extremity
> 8 (10) hours upper extremity

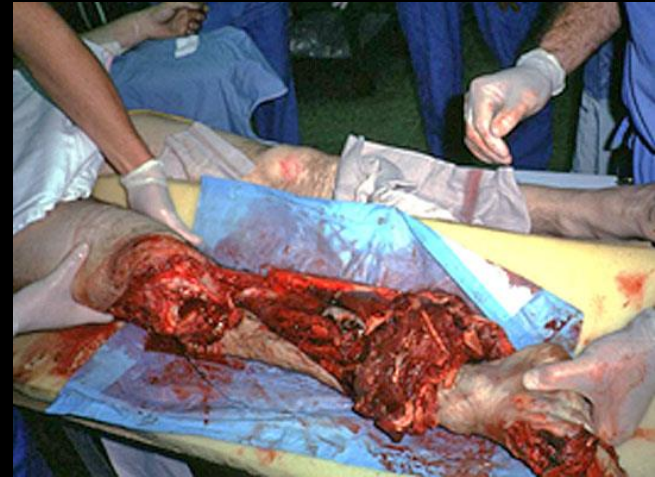


- **Relative criteria:**

- Serious associated injuries (ISS>40)
- Severe ipsilateral foot trauma
- Soft tissue loss beyond free flap reconstruction
- Muscle loss involving > 2 lower leg compartments
- Bone loss involving > 1/3 of the tibia

Primary operation

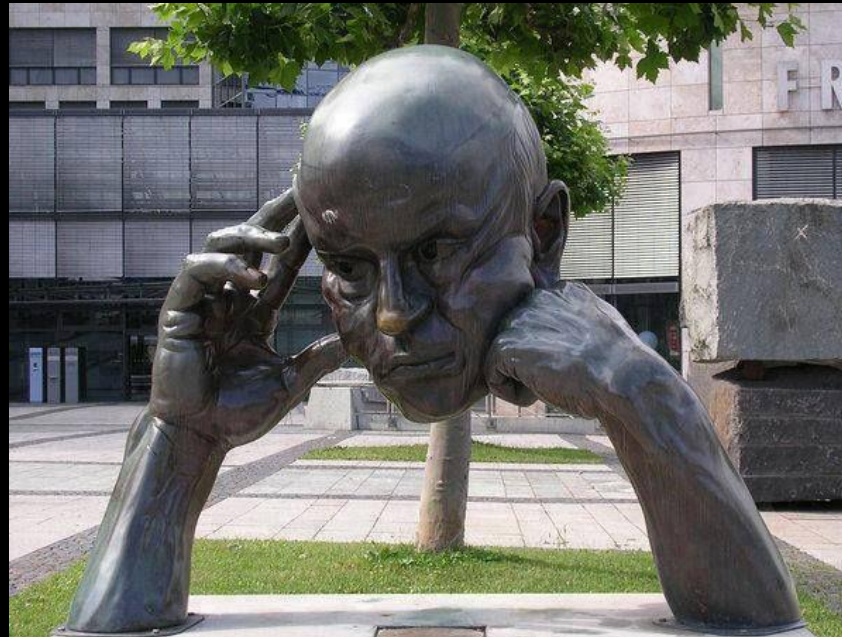
- 1) Sterile tourniquet (not inflated)
- 2) Remove splint and dressing
- 3) Re-examine for perfusion
 - Vascular repair if needed
- 4) Thorough debridement
- 5) Skeletal stabilization



plan?



Salvage or primary amputation (< 30 days)



1. **Is the limb salvable?**
2. **Does salvage give the best functional outcome**

Limb salvage scores

MESI - Mangled Extremity Syndrom Index	Gregory RT	1985
PSI - Predictive Salvage Index	Howe HR	1987
MESS - Mangled Extremity Severety Score	Johansen K	1990
LSI - Limb Salvage Index	Russel WL	1991
NISSA - Nerve injury, Ischemia, Soft tissue injury, Skeletal injury, Shock and Age	McNamara	1994
HFS 98 – Hanover Fracture Scale 98	Krettek C	2001

Limb salvage scores

Mangled Extremity Severity Score(MESS)*

Type	Characteristics	Injuries	Points
Skeletal/soft-tissue Group			
1	Low-energy	- Stab wounds, simple closed fractures, small-caliber gunshot wounds	1
2	Medium-energy	- Open or multiple-level fractures, dislocations, moderate crush injuries	2
3	High-energy	- Shotgun blast (close range) high-velocity gunshot wounds, crush injury	3
4	Very high-energy	- Above + gross contamination, soft tissue avulsion.	4
Shock group			
1	Normotensive hemodynamics	- BP stable in field and in operation theatre	0
2	Transiently hypotensive	- BP unstable in field but responsive to intravenous fluids	1
3	Prolonged hypotension	- Systolic BP less than 90mmHg in field and responsive to intravenous fluids only in operation theatre	2
Ischemia group			
1	None	- A pulsatile limb without signs of ischemia	0*
2	Mild	- Pulse reduced or absent but perfusion normal	1*
3	Moderate	- Pulseless; parasthesia, diminished capillary refill	2*
4	Advanced	- Pulseless, cool, paralyzed and numb without capillary refill	3*
Age group			
1	< 30 years		0
2	> 30 - <50 years		1
3	> 50 years		2

*Points x 2 if ischemia time exceeds six hours, BP - Blood pressure

Score 6 or less → salvageable limb

Score 7 or more → amputation

Limb salvage scores

LEAP study (Lower Extremity Assessment Project)

J Bone Joint Surg Am. 2001 Jan;83-A(1):3-14.

A prospective evaluation of the clinical utility of the lower-extremity injury-severity scores.

Bosse MJ¹, MacKenzie EJ, Kellam JF, Burgess AR, Webb LX, Swiontkowski MF, Sanders RW, Jones AL, McAndrew MP, Patterson BM, McCarthy ML, Cyril JK.

Prospective n = 556

MESS, LSI, PSI, NISSA & HFS

«The low sensitivity, **failed** to support the validity of the **high** scores as **predictors of amputation.**»

“The high specificity of the scores in all of the patient subgroups did confirm that **low scores could be used to predict limb-salvage potential.**”

Plantar sensation

The Insensate Foot Following Severe Lower Extremity Trauma: An Indication for Amputation?

Michael J. Bosse, MD; Melissa L. McCarthy, ScD; Alan L. Jones, MD; Lawrence X. Webb, MD; Stephen H. Sims, MD; Roy W. Sanders, MD; Ellen J. MacKenzie, PhD;

J Bone Joint Surg Am, 2005 Dec; 87 (12): 2601 -2608 . <http://dx.doi.org/10.2106/JBJS.C.00671>



29 patients with insensate foot at time of presentation

At 2 year follow up:

- 55% normal sensation
- 1/29 absent plantar sensation

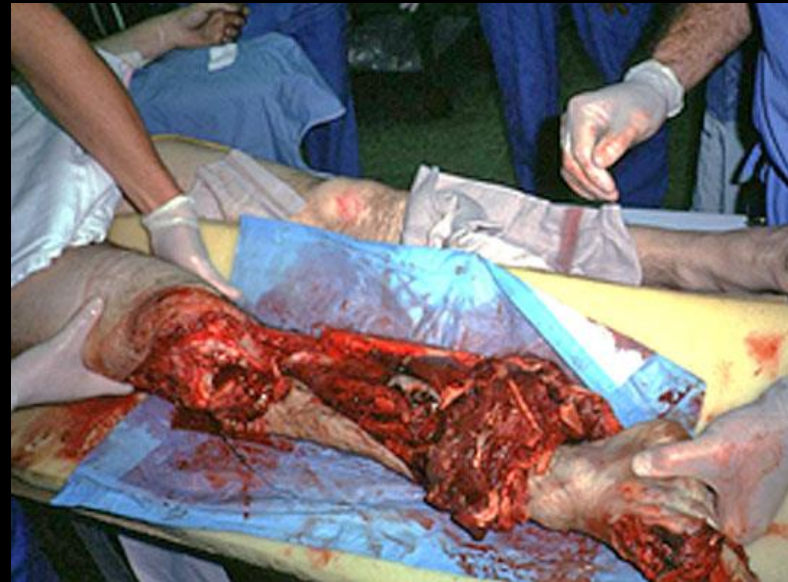
CONCLUSION:

Initial plantar sensation should **not** be a component of a limb-salvage decision algorithm

My decision making

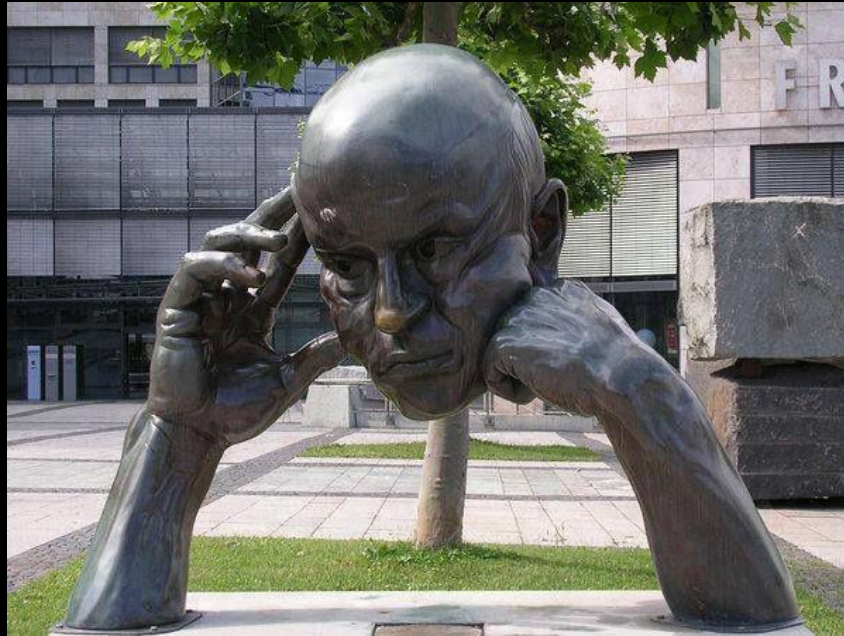
If uncertain, or unknowns, then ALWAYS:

- state probably need for early or delayed primary amputation
- don't spoil amputation stump length
- don't risk life for limb
- get a second opinion



plan?

Salvage or primary amputation (< 30 days)



1. Is the limb salvable?
2. **Does salvage give the best functional outcome**

J Orthop Trauma. 2007 Jan;21(1):70-6.

Complex limb salvage or early amputation for severe lower-limb injury: a meta-analysis of observational studies.

Busse JW¹, Jacobs CL, Swiontkowski MF, Bosse MJ, Bhandari M; Evidence-Based Orthopaedic Trauma Working Group.

Meta analysis – 9 observational studies - 7 years follow up

- **Functional outcome not significantly different**



Outcome LEAP studies Amputation or reconstruction?

- No "right answer"

"Limbs treated with reconstruction can achieve outcomes equivalent to amputees at 2 years."

What are the financial costs?

Lifetime costs:

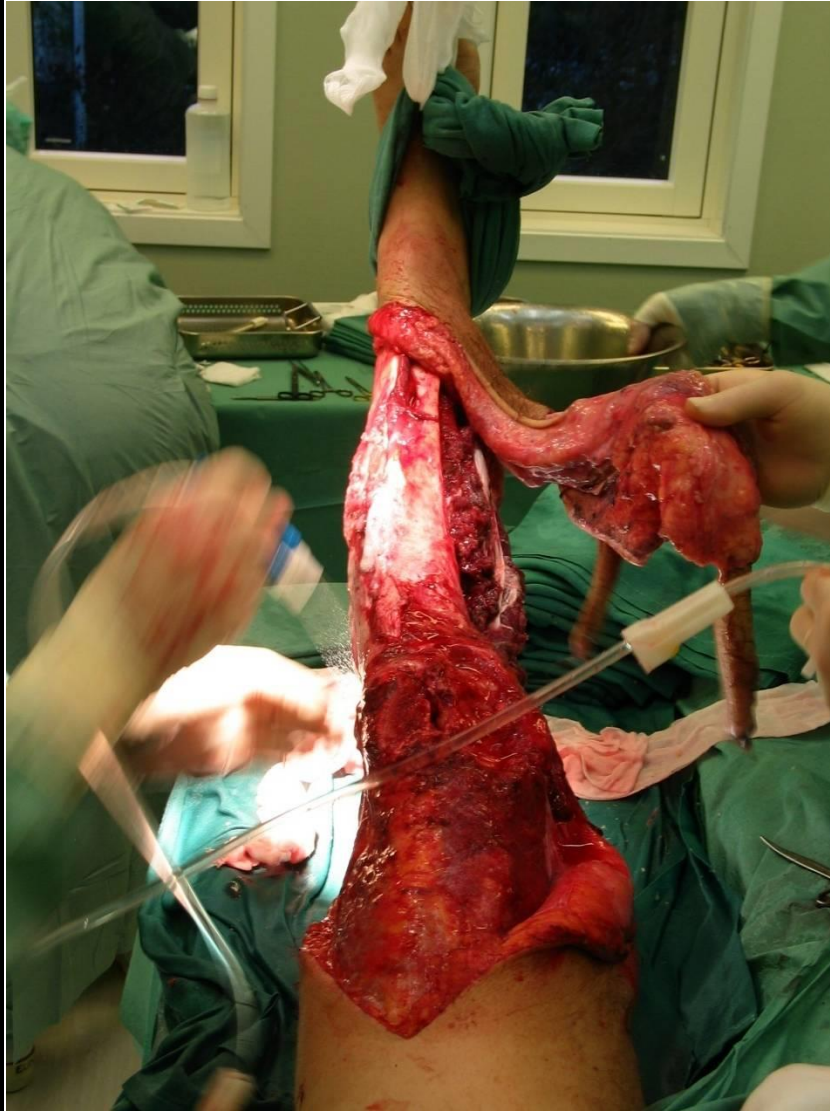
Salvage: **\$ 163 000**

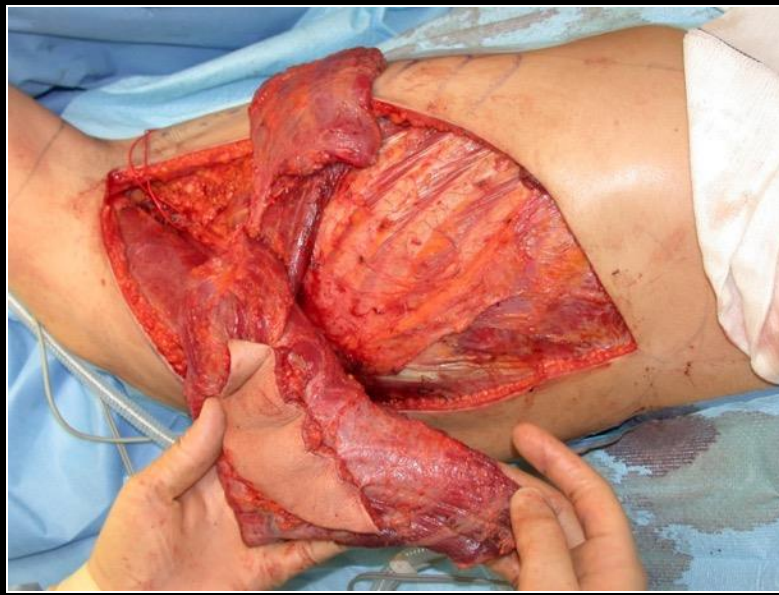
Amputations: **\$ 509 000**

MacKenzie et al (*J Bone Joint Surg Am.*
2007;89:685–1692)



Amputation or reconstruction?





Take home messages

- Life before limb
- Salvage or amputation?
- A (sensible) good shaped foot is critical
- Scores are of limited use and not sensitive
- Reconstruction is much slower and complex
- Amputation is a good option
- No difference in self-reported outcomes

....never decide alone

Outcome LEAP studies



Amputation.....

is not a therapeutic failure



Thank you.....