Treatment of the Mangled Extremity: Salvage vs Amputation

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- All figures belong to Miguel Daccarett, MD unless otherwise indicated”

Learning Objectives

- Limb salvage Vs. amputation, decision-making principles
- Understand the decision-making process in limb salvage Vs. amputation
- Understand where we are and how to make the correct decision

What is the problem??

- Attempting to salvage an extremity without the necessary resources.
- Amputating a limb that could have been salvaged into a functional extremity.
- Attempting to salvage a functionless extremity.
- Attempting to salvage a limb that contributes to the patient's demise. (Bondurant et al, 1988)

"Saving" a limb may ruin a life…

ST Hansen
J Bone Joint Surg Am. 1987;69:799-800.

- **Disabled**
- **Drug-addicted**
- **Destitute**
- **Divorced**
- **Despaired**

What are the variables?

1. The injury
2. The patient
3. The hospital/surgeon

Variable 1: The Injury

Get to know the injury…

not just the radiographs

Don’t forget Documentation

- Take pictures
- Make drawings
- Take radiographs
- Document discussion with the patient

What is the problem?

Making a list:

- Skin
- Muscle
- Nerve
- Blood Vessels
- Bone

What is the problem?
What can we repair/replace?

- Skin Yes
- Muscle No
- Nerve Kind off
- Blood Vessels Yes
- Bone Yes

Management of bone and soft tissues

Bone

- Bone graft
  - Masquelet, Vascularized
- Bone transport
- Bone shortening/lengthening
- Different amputation techniques preserving longer limb
  - Fish mouth/posterior flap

Soft tissues

- Local wound coverage
- Skin preservation
  - “Training the skin”
- Muscle management
  - Myodesis/ Myoplasty
- Rotational flaps
- Free flaps

Variable 2: The patient

Working?

Family?

Disable?

Friends or family support?

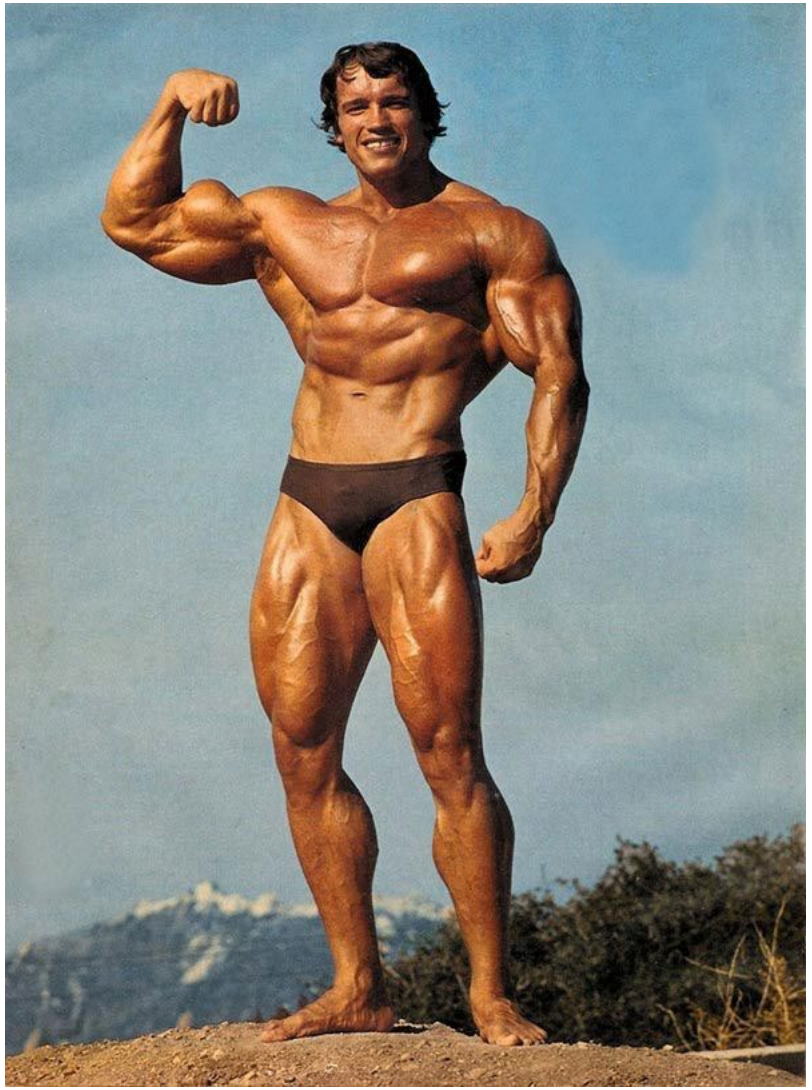
Social history?

Other activities, hobbies?

Goals?

Who is our patient?
We have the answer!

"LEAP patients differ in important ways from the general population".



Characterization of patients with high-energy lower extremity trauma.

MacKenzie et al; J Ortho Trauma 14(7), 2000

- White Male 20-45yo
- 70% High School (86% nationally)
- 25% Below Poverty Line
- 38% No Insurance (20% nationally)
- Heavy drinkers, twice national average
- More neurotic and extroverted

Variable 3: You/Hospital

- The impact of trauma-center care on functional outcomes following major lower-limb trauma.

MacKenzie et al, Bone Joint Surg Am, 2008 Jan;90(1):101-9

"Evidence that patients who sustain high-energy lower-limb trauma benefit from treatment at a level-I trauma center".

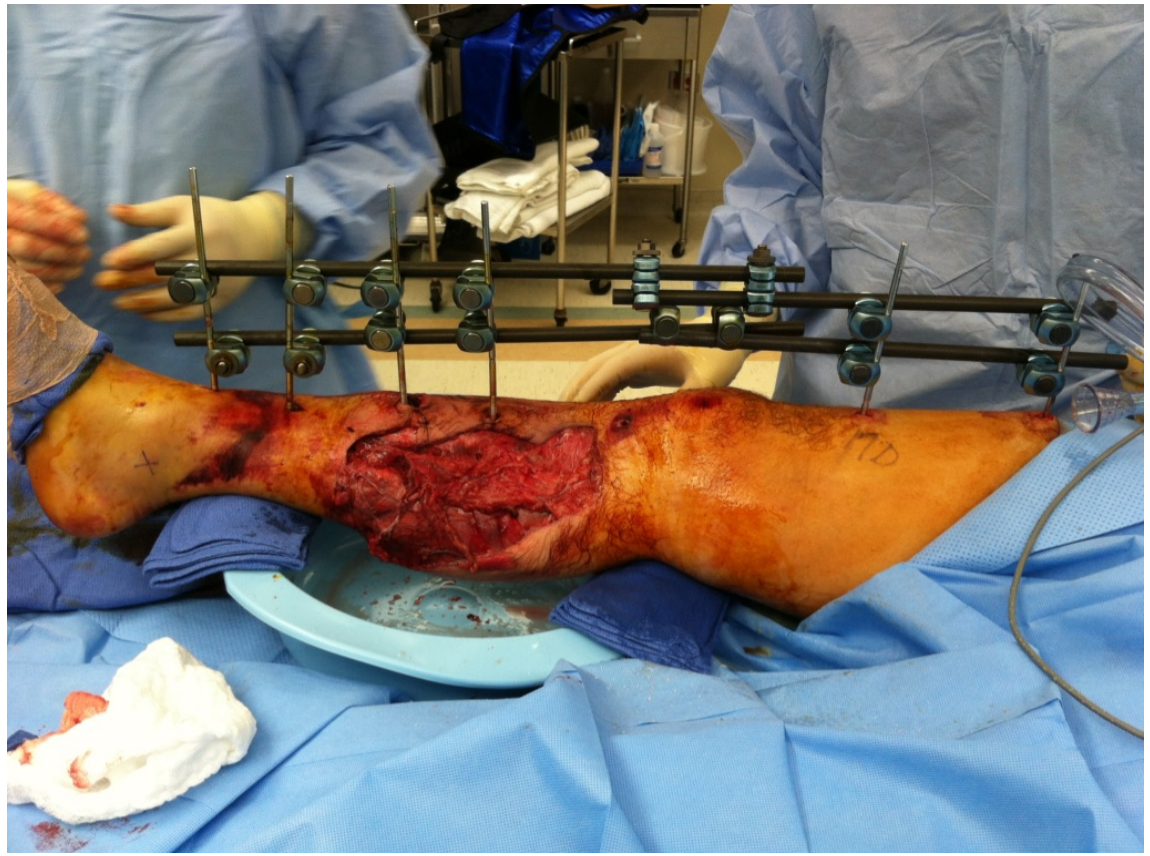
The questions we need to answer!!

1. Is outcome better after amputation or reconstruction?
2. Is there a limb salvage score to help decide?
3. No tibial nerve, no reconstruction?
4. Does foot involvement change plan?
5. What drives patient satisfaction?

LEAP

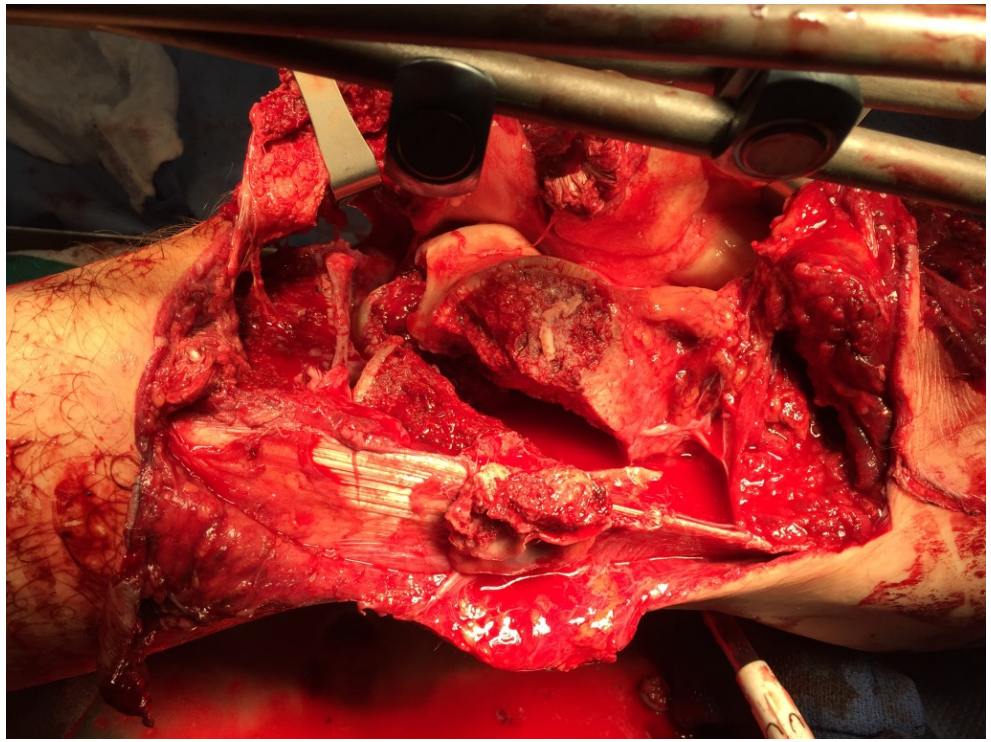
Lower extremity assessment project

Lower Extremity Assessment Project



LEAP Study Design: Inclusion Criteria

Injuries where amputation is a serious consideration



The LEAP Study

- Prospective, observational study
- Evaluation of 601 patients with high-energy lower extremity trauma
- Initially treated at 8 level I trauma centers

Hypothesis: Outcome after **amputation** would be ***better*** than outcome after **reconstruction**

LEAP: Sickness Impact Profile (SIP)

- **High Numbers are Bad**
- Population Average ~2-3
- **>10 = “severe” disability**
- Sensitive to wide range of health conditions and injuries

An analysis of outcomes of reconstruction or amputation after leg-threatening injuries.

N Engl of Med. 2002 Dec 12;347(24):1924-31.

Mean Scores for the Sickness Impact Profile for the 460 Patients Who Were Evaluated 24 Months after Injury

No Difference between treatments.

LEAP: Results

Predictors of High SIP

- Rehospitalization
- Low Education
- Nonwhite Race
- Poverty
- No Health Insurance
- Poor Social Support
- Poor Self Efficacy
- Smoking
- Involvement w/ Litigation

LEAP: Results

What about Long-Term Results?

Long-term persistence of disability following severe lower-limb trauma. Results of a seven-year follow-up Journal of Bone Joint Surg Am. 2005 Aug;87(8):1801-9.

- **Still no difference between groups at 7 years**
- **Both groups worsened**

LEAP: Results

(secondary outcomes)

An Analysis of Outcomes of Reconstruction or Amputation after Leg-Threatening Injuries

Michael J. Bosse, M.D., Ellen J. MacKenzie, Ph.D., James F. Kellam, M.D., Andrew R. Burgess, M.D., Lawrence X. Webb, M.D., Marc F. Swiontkowski, M.D., Roy W. Sanders, M.D., Alan L. Jones, M.D., Mark P. McAndrew, M.D., Brendan M. Patterson, M.D., Melissa L. McCarthy, Sc.D., Thomas G. Travison, Ph.D., et al.

N Engl J Med 2002; 347:1924-1931

No Difference in SIP

Although no difference in SIP the reconstruction group had an increase: in complications, surgery and readmissions.

Is there a limb salvage score to help decide?

MESS

NISSA

Hanover

Mangled Extremity Severity Score

- Evaluated at time of ER presentation
- Simplest to apply of all scoring systems
- Most thoroughly studied
- **A score of less than 7 is supposed to predict limb salvageability**

	Score
Skeletal/soft-tissue injury	
Low energy (stab, fracture, civilian gunshot wound)	1
Medium energy (open or multiple fracture)	2
High energy (shotgun or military gunshot wound, crush)	3
Very high energy (above plus gross contamination)	4
Limb Ischemia (double score for ischemia > 6 hours)	
Pulse reduced or absent but perfusion normal	1
Pulseless, diminished capillary refill	2
Patient is cool, paralyzed, insensate, numb	3
Shock	
Systolic blood pressure always >90 mm Hg	0
Systolic blood pressure transiently <90 mm Hg	1
Systolic blood pressure persistently <90 mm Hg	2
Age	
<30	0
30-50	1
>50	2

Ability of Lower-Extremity Injury Severity Scores to Predict Functional Outcome After Limb Salvage

By Thuan V. Ly, MD, Thomas G. Travison, PhD, Renan C. Castillo, MS, Michael J. Bosse, MD, Ellen J. MacKenzie, PhD, and the LEAP Study Group

THE JOURNAL OF BONE & JOINT SURGERY · JBJS.ORG
VOLUME 90-A · NUMBER 8 · AUGUST 2008

- Low index scores predicted limb salvage potential
- High scores **not accurate** predictors of amputation

DID NOT SUPPORT utility of lower extremity indices to determine salvage vs amputation

What about nerve injury?
Is a Nerve Injury an indication for Amputation?

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

By 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, and the Lower Extremity Assessment Project (*LEAP*) Study Group

The Journal of Bone & Joint Surgery · jbjs.org
Volume 87-A · Number 12 · December 2005

- Half regain sensation by 2 years
- Initial plantar sensation is <u>not prognostic</u> of long-term plantar sensory status or functional outcomes

- **Should <u>not</u> be a component of a limb-salvage decision algorithm**

What about the mangled foot/ankle + free flap vs early BKA?

The Mangled Foot and Ankle: Results From a 2-Year Prospective Study

Journal of Orthopaedic Trauma 2013 Jan;27(1):43-48. The LEAP Study Group

Severe foot and ankle injuries, that require free tissue transfer or ankle fusion, have SIP outcomes that are significantly worse than BKA with typical skin flap design closure.

Last question.
What determines patient satisfaction?

Determinants of Patient Satisfaction After Severe Lower-Extremity Injuries

Robert V. O'Toole, MD, Renan C. Castillo, MS and the LEAP Study GroupJBJS 2008 June 1:90 (6): 1206-1211

Satisfaction driven by:

- Physical function
- Less pain
- Absence of depression
- Ability to return to work at two years

Not driven by:

- Injury
- Underlying psychological characteristics
- Underlying socioeconomic characteristics

The Military Extremity Trauma Amputation/Limb Salvage (METALS) study: outcomes of amputation versus limb salvage following major lower-extremity trauma

Doukas, William C.; Hayda, Roman A.; Frisch, H. Michael; Andersen, Romney C.; Mazurek, Michael T.; Ficke, James R.; Keeling, John J.; Pasquina, Paul F.; Wain, Harold J.; Carlini, Anthony R.; MacKenzie JBJS, 2013 Jan 16;95(2):138-45

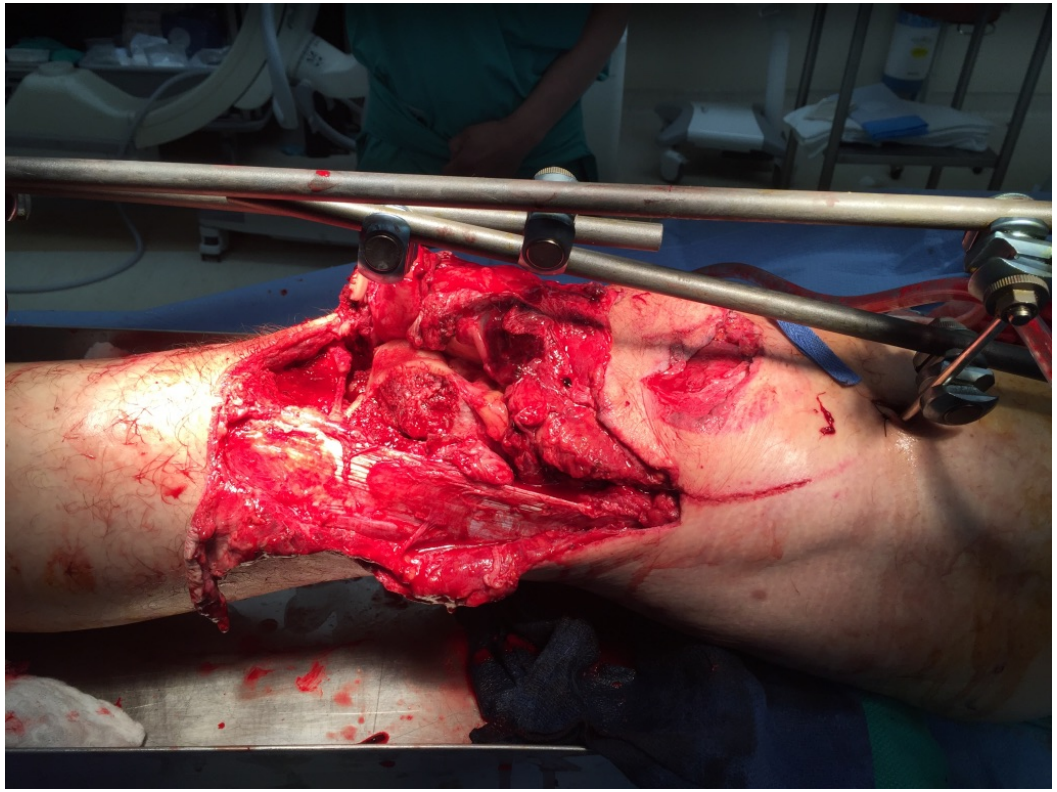
- Amputation appear to have better functional outcomes than those who undergo limb salvage
- **Caution is needed in interpreting these results due to sample population and resources available to them**

Shared Decision Making

- Educate, inform (discuss poor outcomes)
- Mention possibility of late amputation
- Lay out realistic expectations of treatment options
- Involve other physicians in decision (document)
- Take pictures

Shared Decision Making

- With a reasonable degree of medical certainty, there will be complications:
  - Infection
  - Bony
  - Soft tissue
  - Psychological



Shared Decision Making

- Patients will defer to you, remain neutral
- Help patients to make an educated decision based on the information we have
- Involve family and friends
- Do not push or rush decision making process

Summary: Amputation Vs. Salvage

- At 2&7 years: SIP the same
- Complications are lower in amputation group
- High long-term costs to patient and society in both treatment groups
- Limb Assessment Scores: Not helpful
- Plantar Sensation/Nerve Injury: Not helpful
- Foot/Ankle Injuries do worse than BKA

Summary- Decision Making

- Outcomes Poor (Regardless of treatment)

- Consider the whole patient

- Consider resources:
  - Level 1 Trauma Center produces better outcomes-
  - Many additional needs e.g., plastic surgery

- Include patient in decision = Shared Decision Making

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