Lower Extremity Amputation after Trauma

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Disclosures

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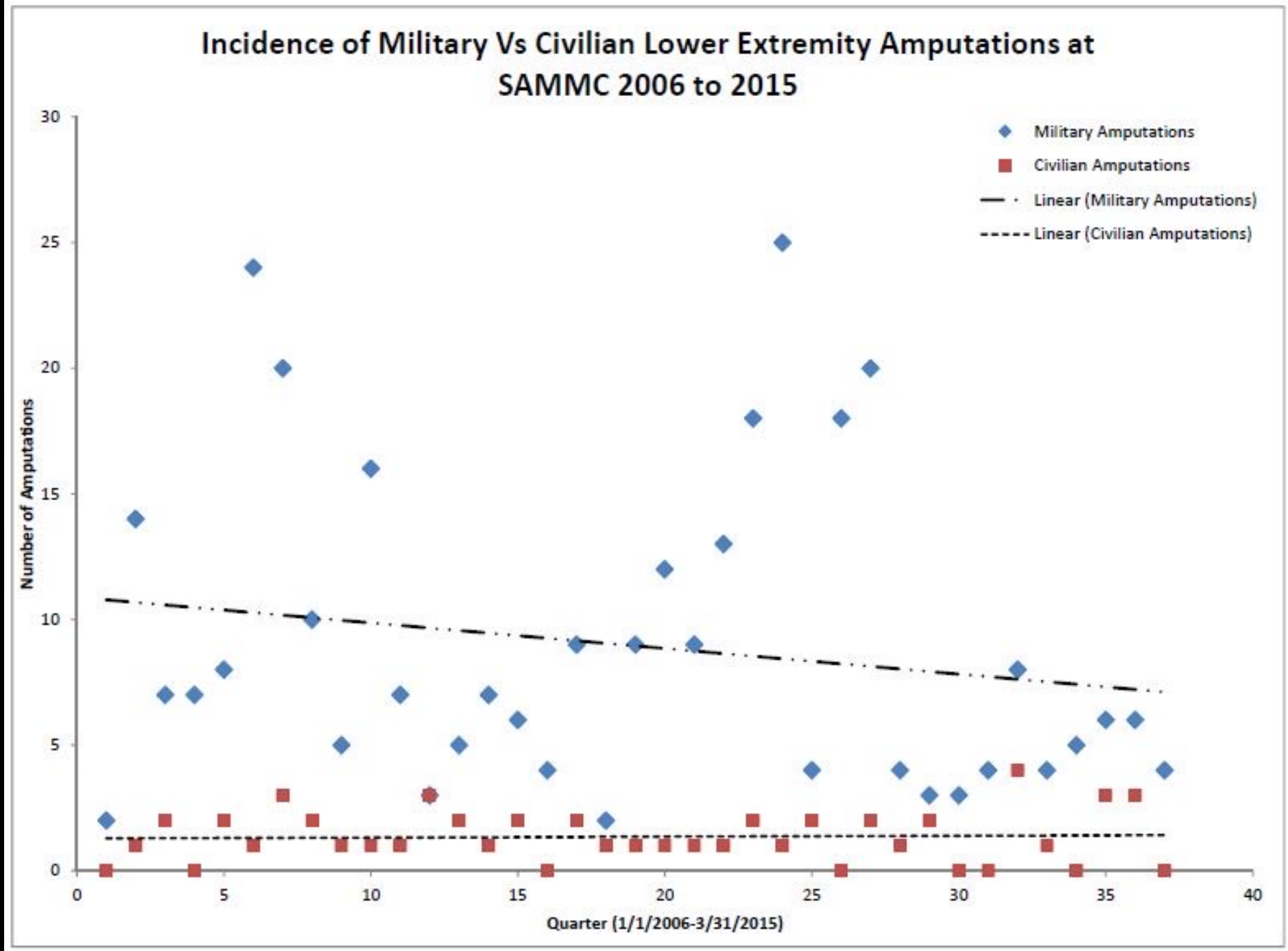
Incidence of Military Vs Civilian Lower Extremity Amputations at SAMMC 2006 to 2015
Military Amputations
Civilian Amputations
Linear (Military Amputations)
Linear (Civilian Amputations)
Number of Amputations
Quarter (1/1/2006-3/31/2015)
0
5
10
15
20
25
30
35
40

Demographics

- 130,000 new amputations/year in US

Causes of Lower Limb Amputations	Percentage of Amputations
Vascular disorders	80
TRAUMA	15
Tumor, infection, congenital	5

- 130,000 x 15% = 19,500 traumatic lower limb amputations/year in US

Keenan MA, Smith DG. Orthoses, Amputations, and Prostheses. *AAOS Comprehensive Review*. Rosemont, IL, American Academy of Orthopaedic Surgeons, 2009:177.

Demographics

- Estimated 16 million people living with an amputation
  - 45% with a traumatic amputation → over 7 million

Ziegler-Graham, MacKenzie EJ, Ephraim PL, et al. Estimating the prevalence of limb loss in the United States: 2005 to 2050. *Arch Phys Med Rehabil*. 2008;89:422-9

- Bottom line: You need to provide these patients with best possible chance at a good outcome

Objectives

- Initial Presentation
- Limb Salvage vs. Amputation?
- General Surgical Goals
- Considerations for Specific Levels

Initial Presentation

- History
- Exam
- Scoring Systems: Useful or NOT USEFUL
- Who Should Be Involved?

Initial Presentation

- Mechanism of injury (How bad is the injury?)
  - High energy vs. low energy?

Injury	Energy (Foot-Pounds)
Fall from curb	100
Skiing injury	300-500
High-velocity GSW	2,000
20-mph bumper injury (striking fixed target, i.e. tibia)	100,000

Chapman MW. Role of bone stability in open fractures. *Instr Course Lect*. 1982;31:75-87.

Initial Presentation in A&E
History

- Mechanism of injury (How bad is the injury?)
  - High energy vs. low energy
  - Degree of contamination
  - Crush?
  - Ischemia time (if present)
- Comorbid conditions (How well are they going to heal?)
  - DM, smoker, PVD
- Social history (How will the injury/treatment impact their life?)
  - Job, education level, access to care, support system

Initial Presentation - Exam

- Overall physiologic status
- Control Hemorrhage
  - Compression dressing/tourniquets when necessary

Kragh JF, Walters TJ, Baer DG, et al. Survival with emergency tourniquet use to stop bleeding in major limb trauma. *Ann Surg 2009*;249:1-7.

- Soft tissue exam
  - Wound size and location
    - Where does the zone of injury end?
  - Skin integrity
    - Burns, abrasions, lacerations, ecchymosis
  - Muscle injury
  - Associated vascular injuries

Initial Presentation

- Radiographs of injured extremity
- Reduce/Immobilize extremity
- Ensure appropriate antibiotics
  - Open fractures
    - Ancef (1st generation cephalosporin)
    - Duration of abx controversial

Holtom, P. Antibiotic Prophylaxis: Current Recommendations. *J Am Acad Orthop Surg* 2006;14 pp S98-S100

Limb Salvage versus Amputation: Myth-Information?

- Absent plantar sensation = amputation
- I'm not sure what to do, I will just use the MESS, or maybe the (insert your favorite scoring system) to make my decision to amputate or reconstruct.
- Amputation is more cost effective
- Patients have better outcomes with amputation

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MYTH BUSTERS

Myth #1: Absent Plantar Sensation = Amputation

- Plantar sensation?
  - Historically used as a predictor of need for amputation
  - Survey of surgeons on factors considered in decision to amputate vs. reconstruct….

Table 3 Percent Distribution of Most Important Factor Typically Considered in Decision to Amputate vs. Reconstruct by Specialty of Respondent

	Total (n = 85) (%)	General Surgeons (n = 33) (%)	Orthopedic Surgeons (n = 52) (%)
Nerve integrity/plantar sensation	32	21	38
Limb ischemia	20	27	15
Soft tissue coverage	14	9	[illegible]
Muscle damage	7	6	8
Neurovascular damage	3	0	6
Fracture pattern/bone loss	4	0	6
High ISS	12	31	0
Patient characteristics	2	0	4
Other	6	6	[illegible]

ISS, Injury Severity Score.

#1 factor for Orthopaedic Surgeons and #3 for General surgeons

#1 for G.S.

Factors Influencing the Decision to Amputate or Reconstruct after High-Energy Lower Extremity Trauma
MacKenzie, E. J. et al.: *J Trauma*. 2002;52:641–649.

Myth #1: Absent Plantar Sensation = Amputation

- Recent data suggests that it should NOT be an indication for amputation
- LEAP Study Group:
  - 55 pts with insensate extremity broken into two groups
    - Insensate that had amputation (n=26)
    - Insensate that had salvage (n=29)
  - Compared to sensate matched control group (n=29)
  - Results:
    - No difference in outcomes between groups
    - Insensate salvage and sensate control group had similar % with normal plantar sensation at 2 yrs (55%)
      - » Only 1 pt in insensate salvage group had absent plantar sensation at 2 yrs

Bosse MJ, McCarthy ML, Jones AL, et al. The insensate foot following severe lower extremity trauma: an indication for amputation? *J Bone Joint Surg Am* 2005;87(12):2601-8.

Limb Salvage versus Amputation: Myth-Information?

BUSTED

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- I'm not sure what to do, I will just use the MESS, or maybe the (insert your favorite scoring system) to make my decision to amputate or reconstruct.
- Amputation is more cost effective
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Myth #2: MESS of 8 = ampu-tate

- Historical Perspective
  - In 1987 Dr. Sigvard Hansen challenged the orthopaedic community “to define clear, concise, acceptable guidelines to help decide which severely damaged extremities are best handled by immediate amputation”

Hansen ST. The type IIIC tibial fracture. Salvage or amputation. *J Bone Joint Surg Am*. 1987;69(6):799-800.

Myth #2: MESS of 8 = ampu-tate

- Historical Perspective
  - The answer came in 1990….The Mangled extremity Severity Score (MESS)
  - Stratified 4 variables: skeletal/soft tissue injury, limb ischemia, shock, and patient age
  - Retrospective and prospective arms confirmed MESS ≥ 7 → amputation

Johansen K, et al. Objective criteria accurately predict amputation following lower extremity trauma. *J Trauma*. 1990;30(5):568-72.

Myth #2: MESS of 8 = amputate

- Goal of scorings systems is to help guide treatment
  - Identify patients where primary amputation would result in better functional outcomes

But the reality is. . .

Table 3
Predictive Salvage Index System*

Criterion	Score
Level of arterial injury	
Suprapopliteal	1
Popliteal	2
Infrapopliteal	3
Degree of bone injury	
Mild	1
Moderate	2
Severe	3
Degree of muscle injury	
Mild	1
Moderate	2
Severe	3
Interval from injury to operating room, hr	
<6	0
6-12	2
>12	4

*Adapted with permission from Howe HR Jr, Poole GV Jr, Hansen KJ, et al: Salvage of lower extremities following combined orthopedic and vascular trauma: A predictive salvage index. *Am Surg* 1987;53:205-208.

Table 4
Mangled Extremity Severity Scoring System*

Factor	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)	
Limb ischemia	
Pulse reduced or absent but p[illegible]	2†
Pulseless, diminished [illegible]	2†
Patient is [illegible] paralyzed [illegible]	3†
Sho[illegible]	
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, yr	
<30	0
30-50	1
>50	2

*Adapted with permission from Johansen K, Daines M, Howey T, et al: Objective criteria accurately predict amputation following lower extremity trauma. *J Trauma* 1990;30:568-573.
†Double value if duration of ischemia exceeds 6 hr.

Table 5
Limb Salvage Index System*

Factor	Score
Arterial injury	
Contusion, intimal tear, partial laceration	0
Occlusion of two or more shank v[illegible]	1
Occlusion [illegible] popliteal, or [illegible] shank [illegible]	2
[illegible] injury	
Contusion, [illegible], minimal clean laceration	0
Partial transection or avulsion of sciatic nerve	1
Complete transection or avulsion of sciatic nerve	2
Bone injury	
Closed fracture or open fracture with minimal comminution	0
Open fracture with comminution or large displacement	1
Bone loss >3 cm; type III-B or III-C fracture	2
Skin injury	
Clean laceration, primary repair, first-degree burn	0
Contamination, avulsion requiring split-thickness skin graft or flap	1
Muscle injury	
Laceration involving single compartment or tendon	0
Laceration or avulsion of two or more tendons	1
Deep vein injury	
Contusion, partial laceration, or avulsion	0
Complete laceration, avulsion, or thrombosis	1
Warm ischemia time, hr	
<6	0
6-9	1
9-12	2
12-15	3
>15	4

*Adapted with permission from Russell WL, Sailors DM, Whittle TB, et al: Limb salvage versus traumatic amputation: A decision based on a seven-part predictive index. *Ann Surg* 1991;213:473-481.

Table 6
NISSA Scoring System*

Factor	Score
Nerve injury	
Sensate	0
Loss of dorsal	1
Partial plantar	2
Complete plantar	3
Ischemia	
None	0
Mild	1†
Moderate	2†
Severe	3†
Soft-tissue injury/ contamination	
Low	0
Medium	1
High	2
Severe	3
Skeletal injury	
Low energy	0
Medium energy	1
High energy	2
Very high energy	3
Blood pressure	
Normotensive	0
Transient hypotension	1
Persistent hypotension	2
Age, yr	
<30	0
30-50	1
>50	2

*Adapted with permission from McNamara MG, Heckman JD, Corley FG: Severe open fractures of the lower extremity: A retrospective evaluation of the Mangled Extremity Severity Score (MESS). *J Orthop Trauma* 1994; 8:81-87.
†Double value if duration of ischemia exceeds 6 hr.

Dirschl, D.R. : The Mangled Extremity: When Should It Be Amputated? *J Am Acad Orthop Surg* 1996;4:pp 182-190

Myth #2: MESS of 8 = ampu-tate

- Scoring systems are NOT predictive of successful limb salvage

- Retrospective study demonstrated that available scoring systems are not predictive of successful limb salvage
  - Mangled Extremity Syndrome Index (MESI)
  - Mangled Extremity Severity Score (MESS)
  - Predictive Salvage Index (PSI)
  - Limb Salvage Index (LSI)

Bonanni F, Rhodes M, Lucke JF: The futility of predictive scoring of mangled lower extremities. *J Trauma* 1993;34:99-104.

Myth #2: MESS of 8 = ampu-tate

- The LEAP Study Group performed an independent, prospective evaluation of lower-extremity injury-severity scores, i.e. best available data

  …NOT predictive of amputation

- From the abstract:
  - Results: The analysis did not validate the clinical utility of any of the lower-extremity injury-severity scores.
  - Conclusions: Lower-extremity injury-severity scores at or above the amputation threshold should be cautiously used by a surgeon who must decide the fate of a lower extremity with a high-energy injury.

Bosse MJ, MacKenzie EJ, Kellam JF, et al. A prospective evaluation of the clinical utility of the lower-extremity injury-severity scores. *J Bone Joint Surg Am* 2001;83(1):3-14.

Limb Salvage versus Amputation: Myth-Information?

- Absent plantar sensation = amputation

- I'm not sure what to do, I will just use the MESS, or maybe the (insert your favorite scoring system) to make my decision to amputate or reconstruct.

- Amputation is more cost effective

- Patients have better outcomes with amputation

BUSTED

BUSTED

Myth #3: Amputation is more cost effective

- Study 1
  - The costs for the sixteen patients who had had a successful limb salvage were compared with eighteen who had an early amputation (within 3 weeks).
  - The median total adjusted hospital charge for early amputation was $65,624. This was significantly less ($p < 0.006$) than the median total adjusted hospital charge of $109,044 for the limb salvage group.
  - Major Shortcoming → Only compared **hospital charges** during duration of follow-up

Georgiadis GM, et al. Open tibial fractures with severe soft-tissue loss. Limb salvage compared with below-the-knee amputation. *J Bone Joint Surg Am*. 1994;76(10):1594-5.

Myth #3: Amputation is more cost effective

- Study 2
  - 39 Type IIIB or C open tibia fractures
    - 21 limb salvage
    - 18 amputation
  - Collected data on hospitalization, costs, and employee compensation allowances
  - Reported significantly higher hospital costs in salvage group
  - Loss-of-wages benefits were paid to salvage patients for period of 2.5x's longer

	Amputation	Reconstruction
Hospital costs	60′000 SF	69′000 SF
Loss-of-wages benefits	38′000 SF (for 365 days)	96′000 SF (for 900 days)
Indemnity for loss of integrity	25′000 SF	19′000 SF
Pension	240′000 SF (25% pension from age 23)	0
Total costs	363′000 SF	184′000 SF

Hertel R, Strebel N, Ganz R. Amputation versus reconstruction in traumatic defects of the leg: Outcomes and costs. *J Orthop Trauma*. 1996;10(4):223-9.

Myth #3: Amputation is more cost effective

- The True Costs Revealed…The LEAP Study Group strikes again

- 2 year costs (incl. prosthesis)
  - Salvage $81,316.00
  - Amputation $91,106.00

MacKenzie et al. Health-Care Costs Associated with Amputation or Reconstruction of a Limb-Threatening Injury. J Bone Joint Surg Am. 2007;89:1685-92

Myth #3: Amputation is more cost effective

- The True Costs Revealed…The LEAP Study Group strikes again

- 2 year costs (incl. prosthesis)
  - Salvage $81,316.00
  - Amputation $91,106.00

- Projected lifetime cost (incl. purchase/maint. prosthetics)
  - Salvage $163,282.00
  - Amputation $509,275.00

MacKenzie et al. Health-Care Costs Associated with Amputation or Reconstruction of a Limb-Threatening Injury. J Bone Joint Surg Am. 2007;89:1685-92

Limb Salvage versus Amputation: Myth-Information?

BUSTED

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- Amputation is more cost effective
- Patients have better outcomes with amputation
  - Those undergoing limb salvage end up "divorced, demoralized, and destitute"

Hansen ST. The type IIIC tibial fracture. Salvage or amputation. *J Bone Joint Surg Am*. 1987;69(6):799-800.

Myth #4: Functional outcomes are better with amputation

- Early studies demonstrate the significant impact a trauma-related amputation has on functional outcomes

Pierce RO Jr, et al. The plight of the traumatic amputee. Orthopedics. 1993;16:793-7.

Smith DG, et al. Prosthetic history, prosthetic charges, and functional outcome of the isolated, traumatic below-knee amputee. *J Trauma*. 1995;38:44-7.

- And comparisons of outcomes between groups led to recommendations for early amputation

Fairhurst MJ, et al. The function of below-knee amputee versus the patient with salvaged grade III tibial fracture. *Clin Orthop Relat Res*. 1994;301:227-232.

Georgiadis GM, et al. Open tibial fractures with severe soft-tissue loss: lim salvage compared with below-the-knee amputation. *J Bone Joint Surg Am*. 1993;75:1431-41.

Myth #4: Functional outcomes are better with amputation

- This previous data supporting early amputation led the LEAP investigators to hypothesize that "those undergoing amputation would have better outcomes than those undergoing reconstruction."
- What they found → No difference in SIP scores at 2 and 7 years
  - Predictors of poor outcome, regardless of group
    - Rehospitalization for a major complication, low education level, nonwhite race, poverty, lack of private health insurance, poor social-support network, low self-efficacy, smoking, and involvement in disability-compensation litigation.

Bosse MJ, et al. An analysis of outcomes of reconstruction or amputation of leg-threatening injuries. *N Engl J Med*. 2002;347:1924-31.

MacKenzie EJ, et al. Long-term persistence of disability following severe lower-limb trauma. Results of a seven year follow-up. *J Bone Joint Surg Am*. 2005;87(8):1801-9

Myth #4: Functional outcomes are better with amputation

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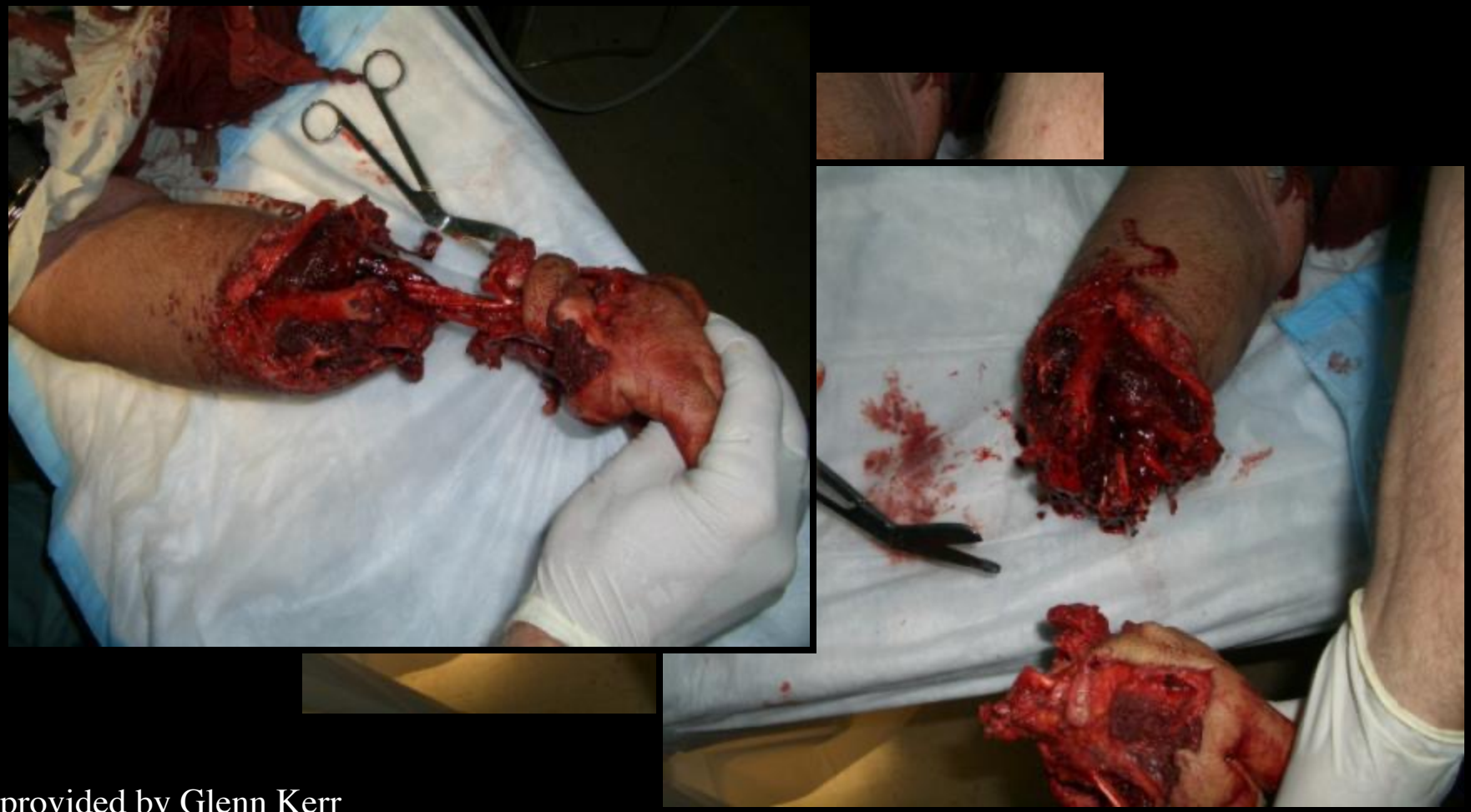
BUSTED
BUSTED
BUSTED
BUSTED

Now What?

That doesn’t make the
decision any easier?

Decision to Amputate

- Sometimes the decision is easy…



Slide provided by Glenn Kerr

General Goals

- Retain clean, perfused tissue
  - Debride all non-viable tissue
- Preserve length
- Preserve skin
- Balance forces of remaining muscles

- Ultimate goal: Return to functional level that meets the patient's need

Best Available Evidence

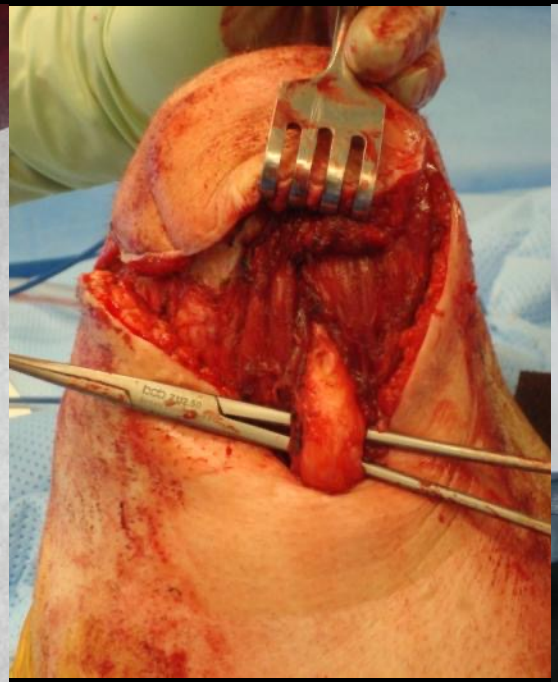
- LEAP: Prospective, observational study
  - 149 patients who sustained high energy lower extremity trauma treated with a trauma-related amputation
    - 30% were rehospitalized
    - 14.5% revision rate of residual limb

HIGH RATE OF COMPLICATIONS

Harris AM, Althausen PL, Kellam J, et al. Complications following limb-threatening lower extremity trauma. *J Orthop Trauma*. 2009;23:1-6.

Make It Count

Good



Bad

Ugly

Properly Performed Surgery

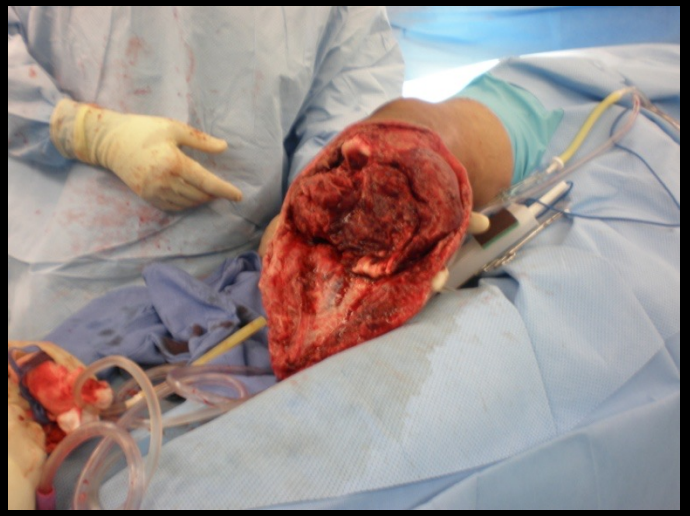
- Reconstructive
- Functional end organ

“ Amputation surgery is not hard… but

Improperly Performed Surgery

…easy to perform poorly”

- Wound healing
- Painful residual limb
- Prosthetic fitting
- Repeat surgery



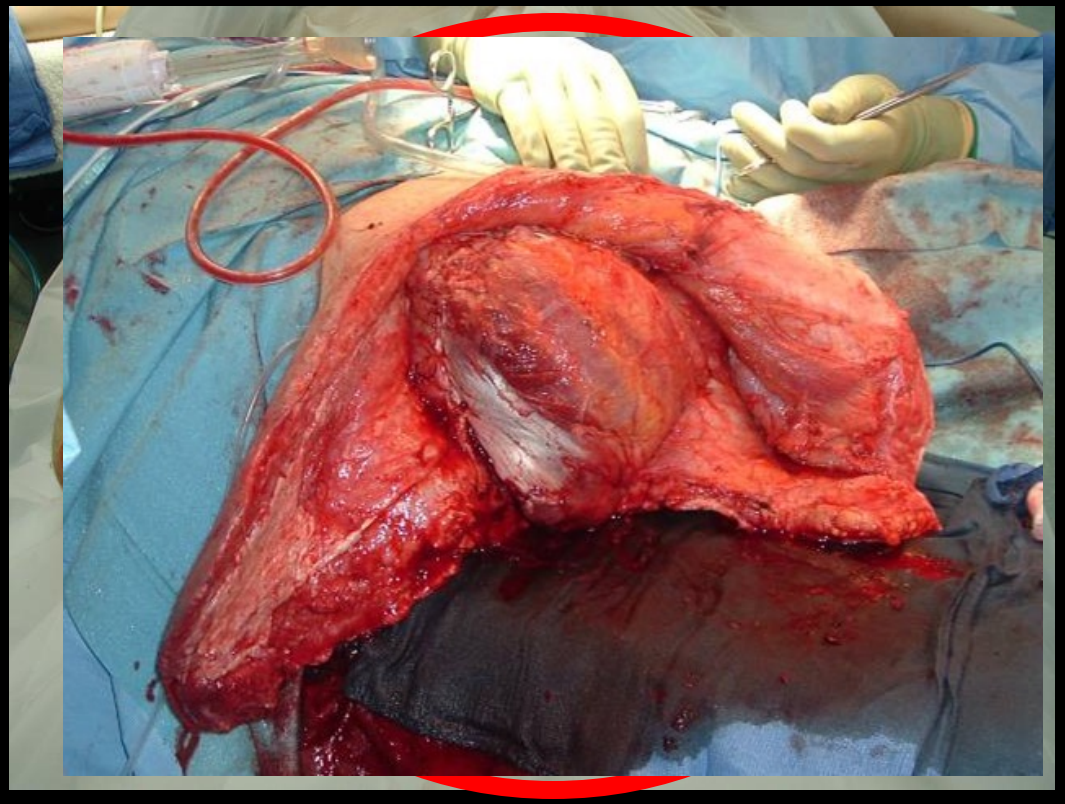
General Principles

Initial Management: Key Points

- ABC's
- Hemostasis
- Antibiotics, tetanus, resuscitation/transfusion
- Urgent sharp debridement and copious irrigation

Soft Tissue Envelope

- Guillotine Amputations
  - Antiquated and rarely indicated
  - Sacrifice length/viable, available tissue
  - Not that much faster
- **<u>Open, length-preserving technique advocated</u>**



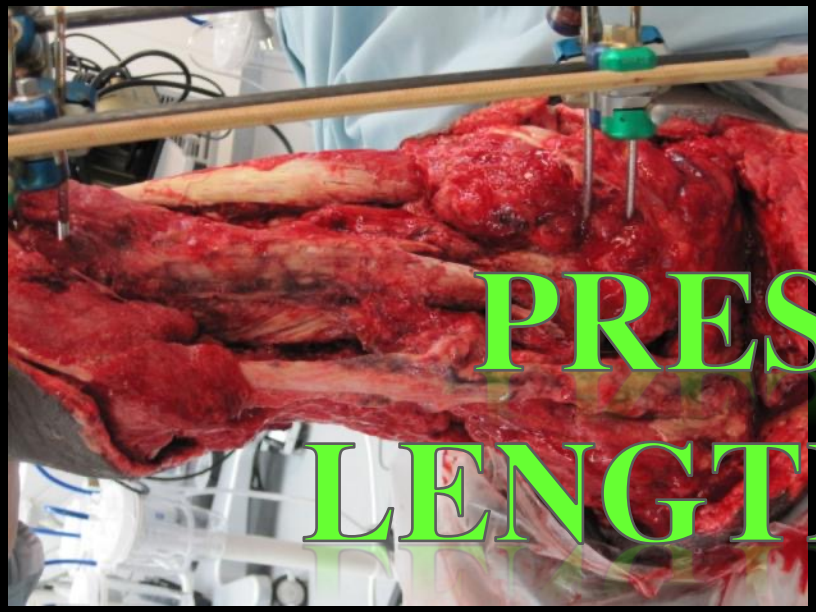
Approved solution

Soft Tissue Envelope

- Prefer full-thickness flaps
- Avoid undermining myocutaneous flaps
  - Preserves maximum tissue
  - Sacrifice some length for good tension free closure
  - STSG/ Dermal substitutes useful – do not take donor from ipsilateral limb - Newer prostheses can offload areas

Timing of Closure

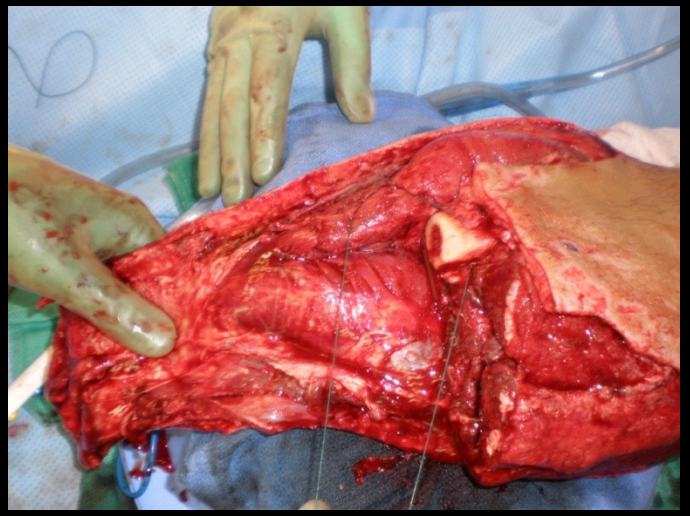
- **DELAYED!**
  - Wide, slowly evolving zone of injury
  - Serial debridements
  - NPWT useful

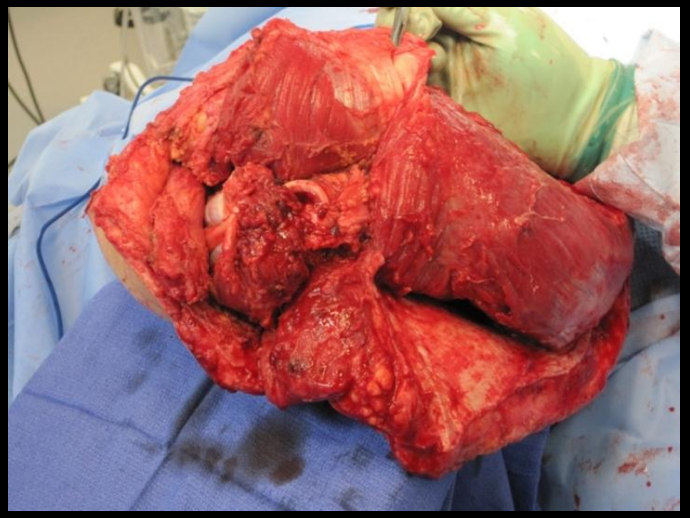


PRESERVE LENGTH WHEN TISSUE VIABLE

Amputation Technique- Muscle

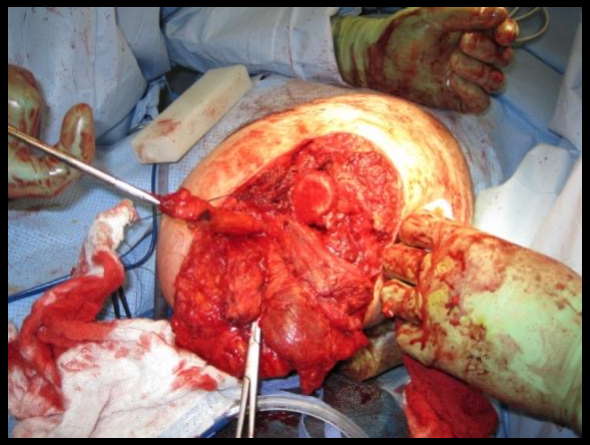
- Myodesis
  - Direct attachment to bone/periosteum
  - Stabilize primary muscle groups
- Myoplasty
  - Fascia/ antagonist muscle
    - Preserve fascial layer
    - Attachment for secondary muscles

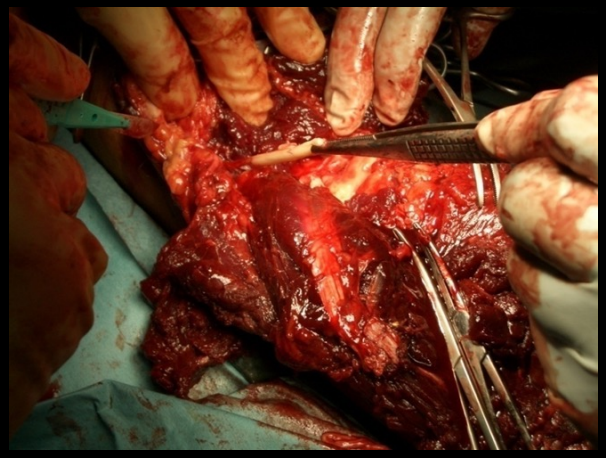




Nerve Management

- Sectioned nerve - 100% neuroma
- Gentle traction - sharp division
- Avoid “group” ligation
  - Pulsating vessel sutured to a nerve not ideal
- Targeted Muscle Reinnervation (TMR)





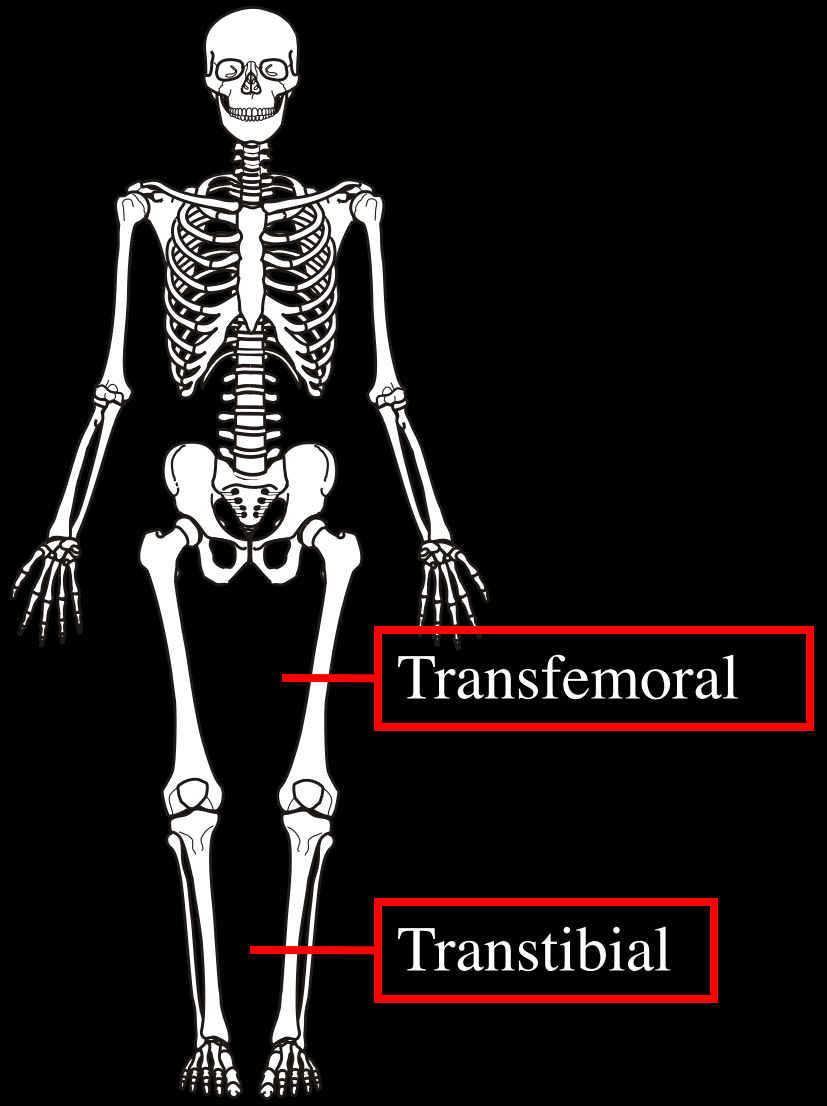
Vessel Management

- Ligate with non-absorbable suture
- Separate artery and vein(s)
  - More secure ligation/hemostatsis
  - Theoretical risk of A-V fistula/shunt/steal

- Double ligate proximal to knee
  - Suture ligature “stick tie” + Ligature “tie”
  - Avoid pulsating vessel pushing off the tie

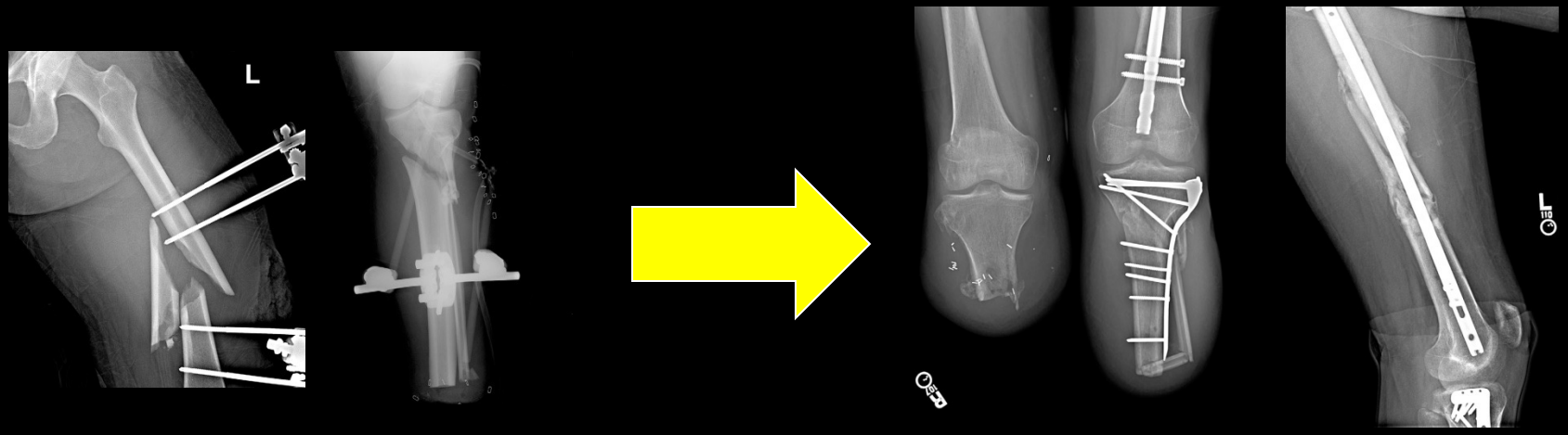
Level Selection

- Most distal that will predictably heal
- Zone of injury
- Vascularity
- Lower Extremity
  - Partial foot
  - Transtibial
  - Knee Disarticulation
  - Transfemoral



Proximal Fractures

- Preserve length whenever possible
- Proximal fractures of ipsilateral limb can be fixed
- High rate of infection (89%), they all healed



Gordon WT, et al. Outcomes associated with the internal fixation of long-bone fractures proximal to traumatic amputations. *J Bone Joint Surg Am* 2010;92:2312-8.

Foot : General Principles

- Critical factors:
  - Tendon balancing/transfers – prevent equinus and equinovarus
    - Lengthen heel cord
    - Transfer TA proximally if needed
  - Robust, sensate plantar soft tissue envelope
- Proximal to transmetatarsal/Lisfranc… young, active patients may be functionally better off without a foot
- Maintain foot length
- Longitudinal amputations better than shortening

Lisfranc/Transmet Amputation

- Key points to consider:
  - Leave bases of 2nd – 5th MTs
    - Preserves transverse arch
    - Peroneus brevis insertion
  - Preserve the TA and PL
    - If amputating more proximal, i.e Chopart (talonavicular/calcaneocuboid), perform tendinous reconstruction of TA to counteract forces of the triceps surae
    - Goal: To avoid equinovarus deformity

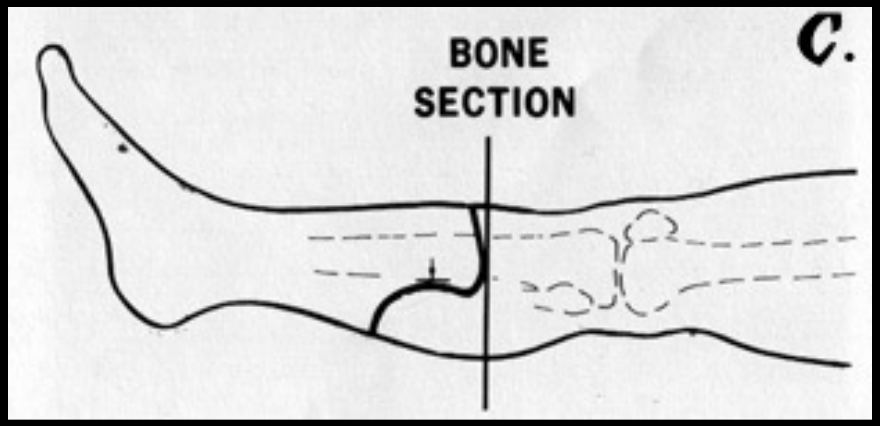
Greene WB, Cary JM. Partial foot amputationsin children. A comparison of the several types with the Syme amputation. *J Bone Joint Surg Am*. 1982;64:438-43.

Partial Foot Amputation

Rigid shank/shoe filler

Transtibial

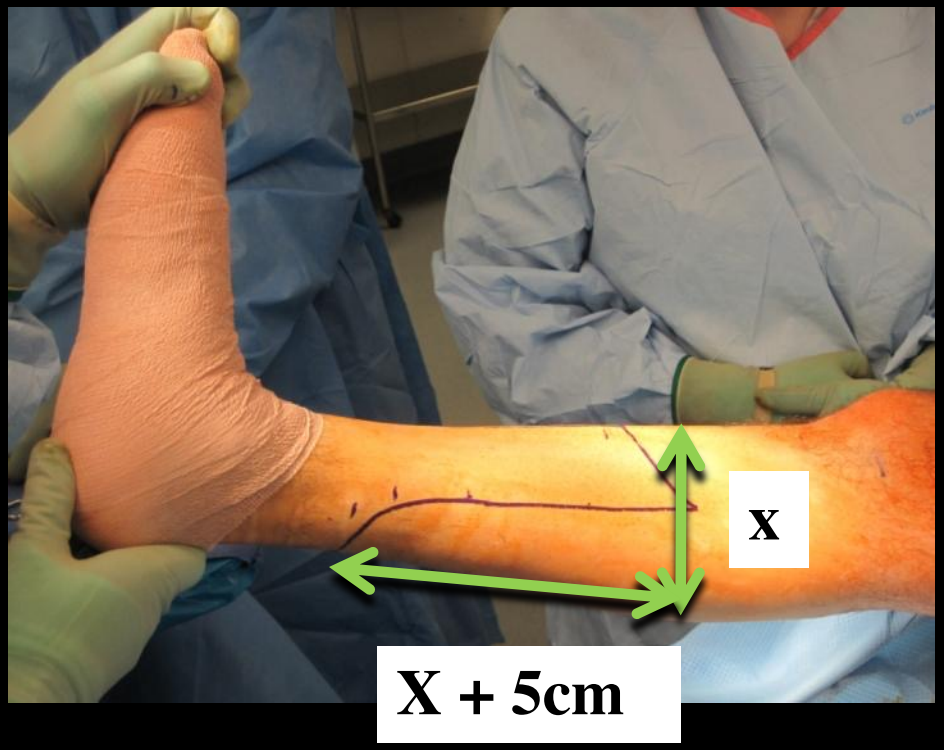
- Most common level
  - Especially in isolated trauma
  - Very functional
  - "Preferred" level
- Short BKA > AKA > TKA
  - Save the knee joint!!
- Distal 1/3 Amputations
  - May Require Revision to higher level
  - Minimal soft tissue coverage



Munin, M.C., Galang, G.F. : Limb Amputation and Prosthetic Rehabilitation. *Orthopaedic Knowledge Update 8*. Rosemont, IL 2005, pp 645-654

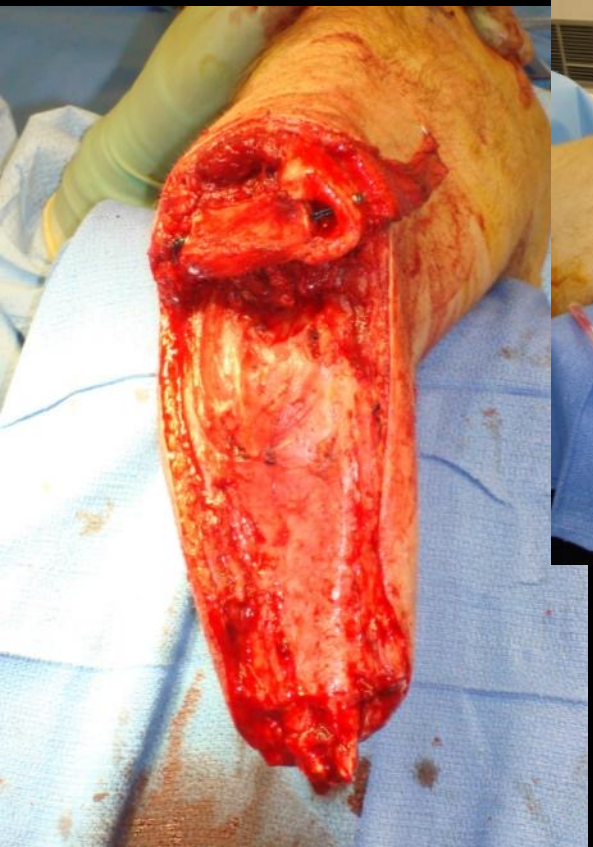
Skin Flaps: Extended Posterior Flap

- Preferred technique
- Extended:
  - Diameter of leg + 5 cm
- Standard:
  - Diameter of leg + 1-2 cm
- Can always cut more skin but cannot put it back



Assal M, et al. Extended posterior flap for transtibial amputation. *Orthopedics*. 2005;28:542-6.

Transtibial Amputation: Extra-long Posterior Flap



Skin Flaps:
Atypical Flaps

- Extended flap not always possible!!

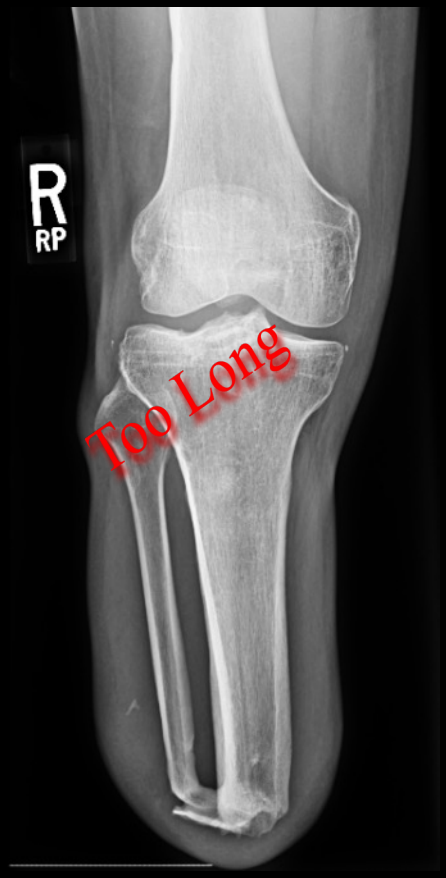
But still possible to have
a nice outcome

Transtibial Amputation

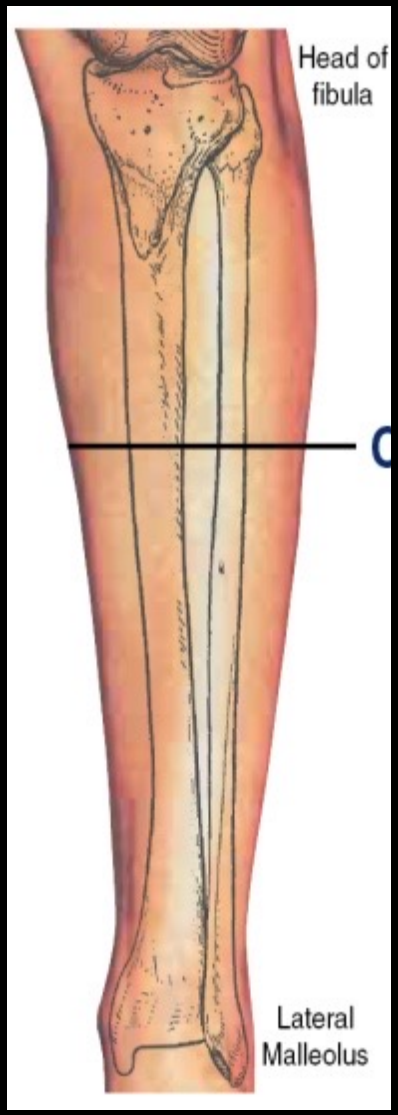
- Whenever possible → salvage knee joint
  - Free tissue transfer
  - STSG – Newer prostheses can offload area

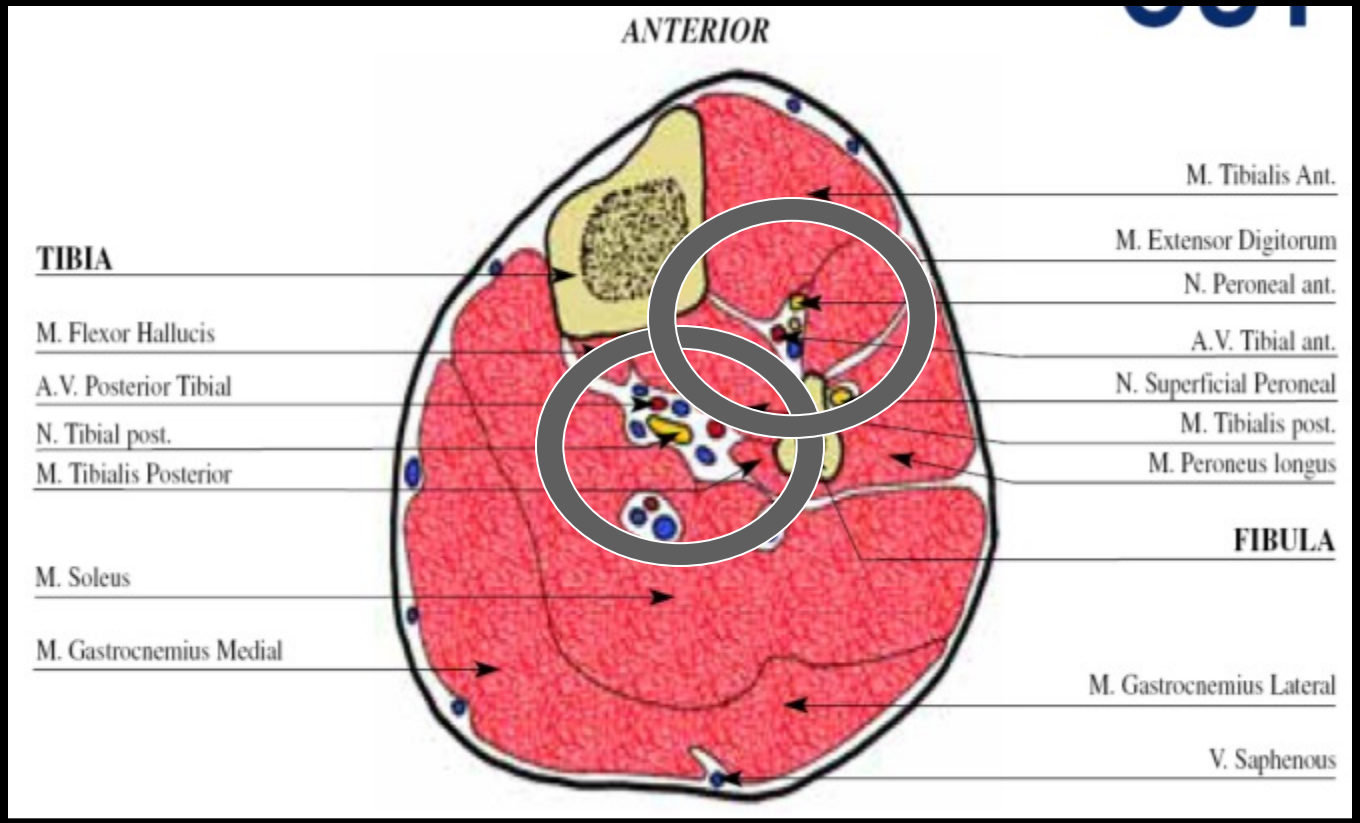
Transtibial Amputation

- Bone cut selection
  - Dictated by soft tissues
  - 2.5cm per 30cm height= 12.5-17.5cm
  - Need 10.5-11 in (27-28cm) from heel
    = prosthesis build height
- Level sectioning
- Appropriate bevel



Know Your Anatomy





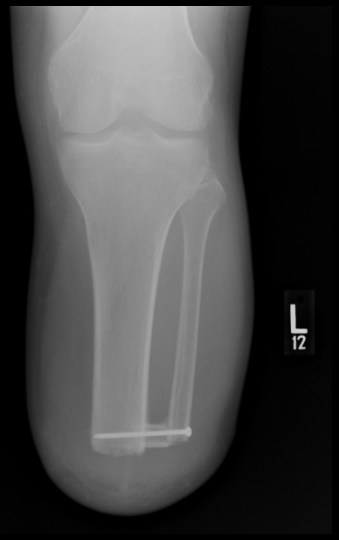
Catagni, M.A. : Atlas for the Insertion of Transosseous Wires and Half-pins, *ILIZAROV METHOD*; Milan, Italy, Medi Surgical Video 2003; pp 1-50

The Controversy!!!

- To bridge or not to bridge…

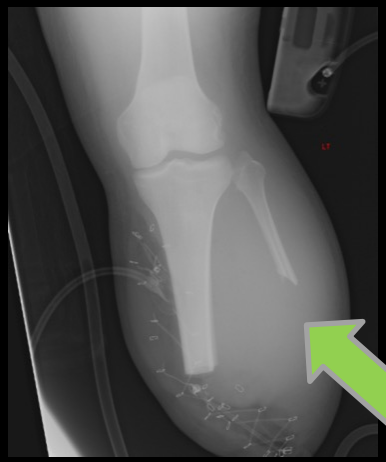
- Non-bone Bridge (Burgess)
  - Fibula cut short by 1-2 cm

- Bone Bridge (Ertl)
  - End bearing?
    - Clinical relevance with modern prostheses unknown
  - More consistent limb shape
  - Stabilizes fibula



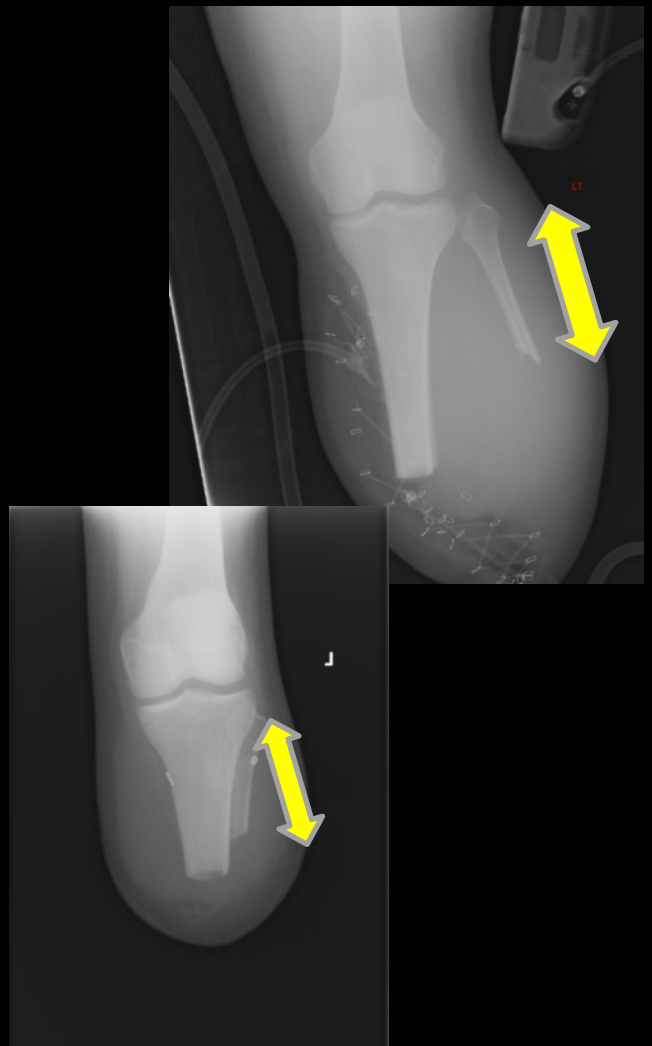
Transtibial Amputation: Ertl/ Bridge Synostosis

- Outcomes
  - Functional benefit controversial
  - Theoretically more stable/broad weight bearing surface
- Indications:
  - Overt clinical/radiographic fibular instability
    - Or late symptoms of same
  - Patient/surgeon preference



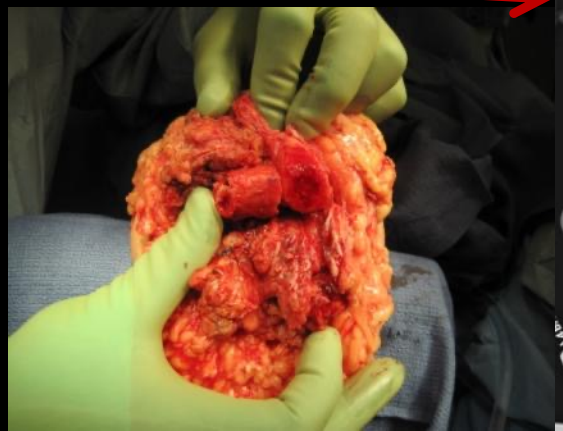
Transtibial Amputation: Modified Ertl

- Contraindications:
  - Overt/active infection
  - Inadequate fibular length
- Relative:
  - ZOI
  - Compromised soft tissue coverage



Transtibial Amputation: Modified Ertl

- Operative techniques
  - Graft sources:
    - Osteoperiosteal sleeve (classic)
    - Fibular bridge (vascularized or non-)
    - Tibial trapdoor/drawbridge
    - Iliac crest
  - Bridge Fixation
    - Suture
    - Screw
    - Tightrope

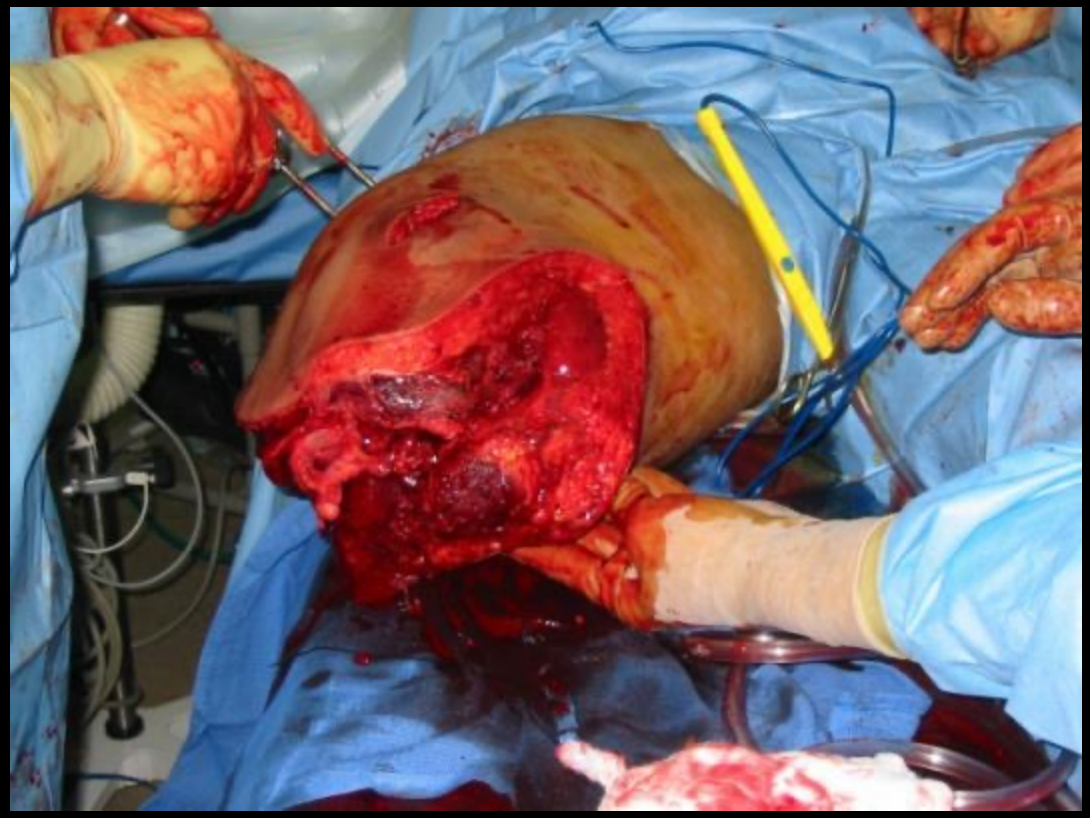


Transtibial Amputation: Modified Ertl

- The Goal

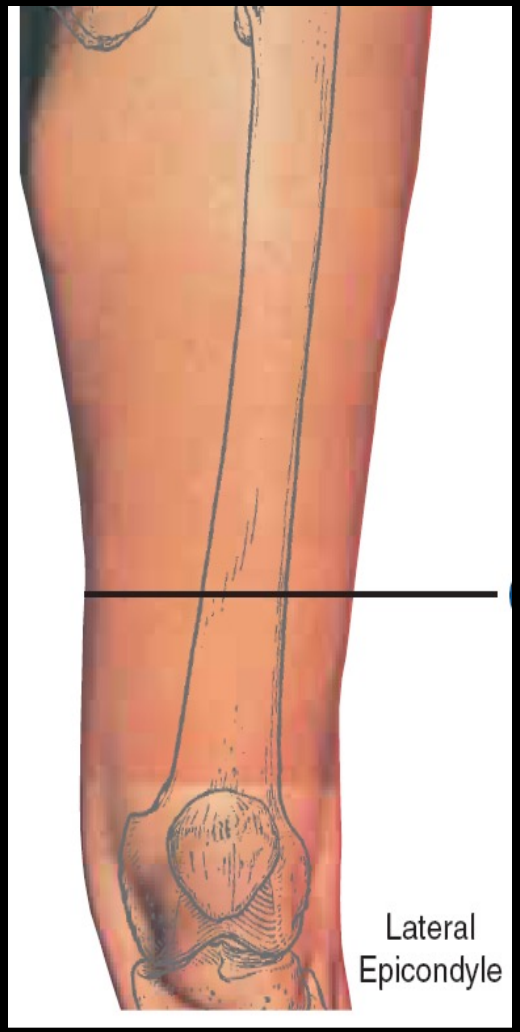
Transfemoral Amputation

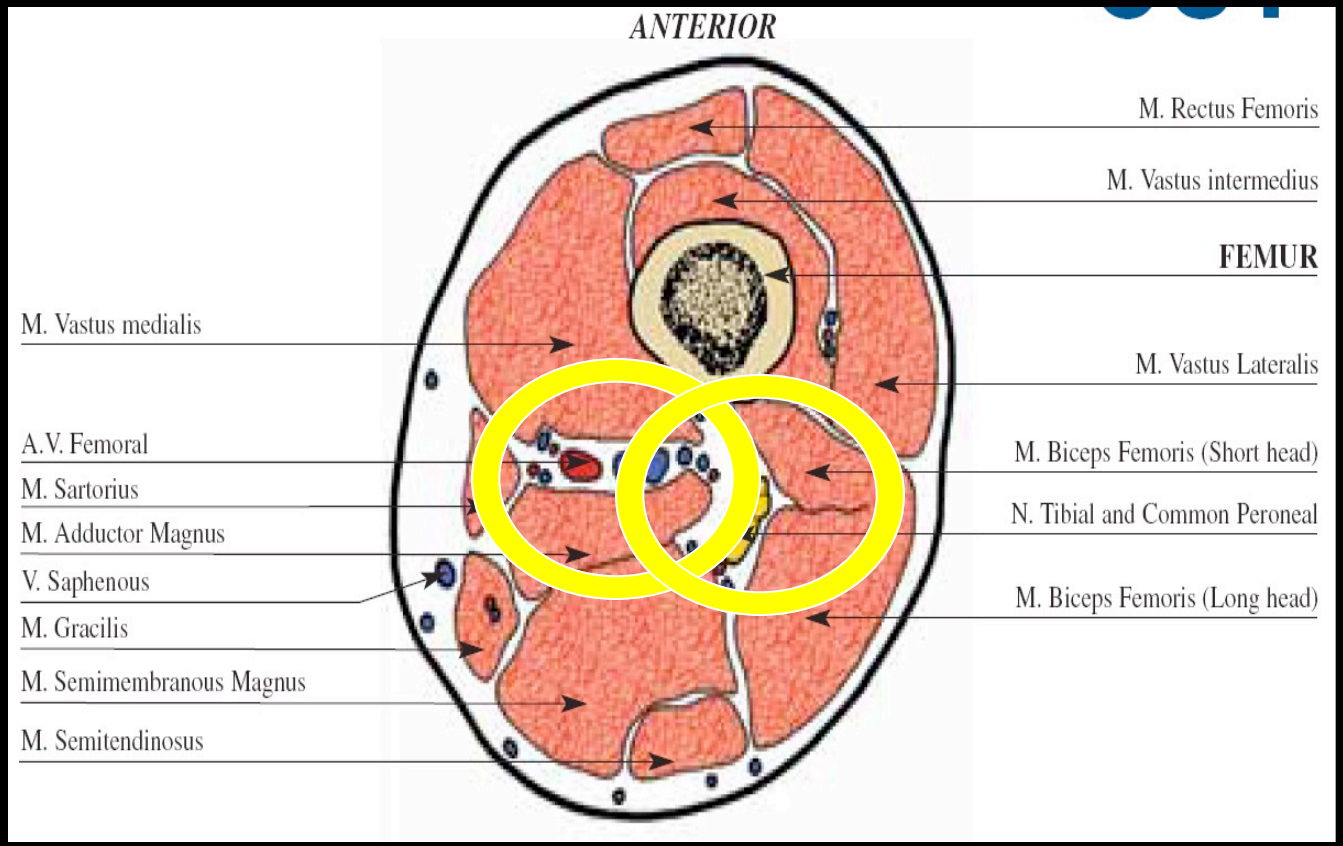
- Preserve Length
  - Leave muscle 2.5cm longer than bone when possible
- 12 to 14cm above knee
- <5 cm below Greater Troch = Fitted as a Hip Disarticulation
- Long Medial Based Flap
- Adductor Magnus Tendon
  - Hunter's Canal
  - Tag Suture/double ligate vessels
    - Stick tie & free tie



Gottschalk, F. : Transfemoral Amputation : Surgical Management, *Atlas of Amputations and Limb Deficincies.* Rosemont, IL, American Academy of Orthopaeidc Surgeons, 2004; pp 533-540.

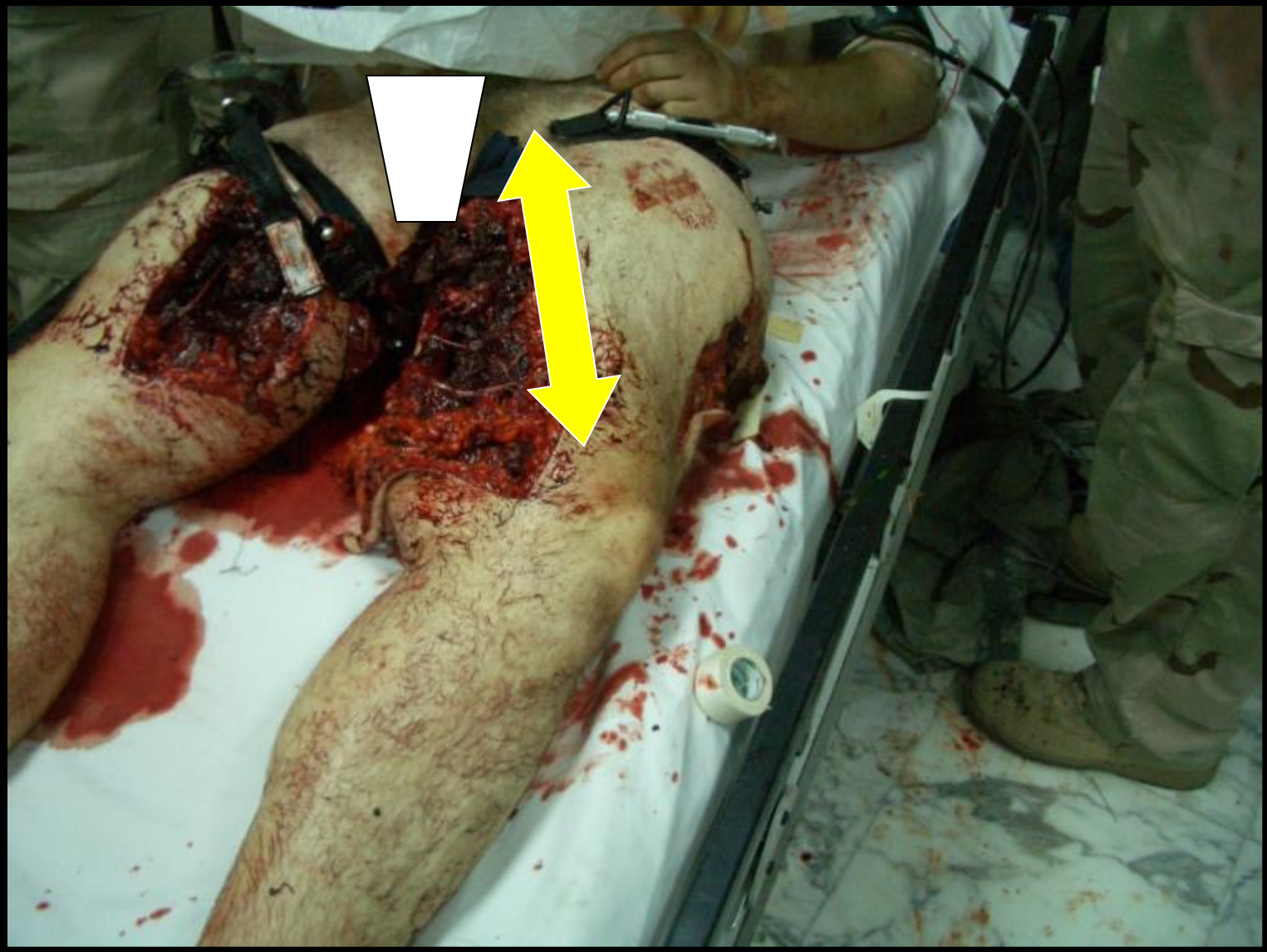
Know Your Anatomy

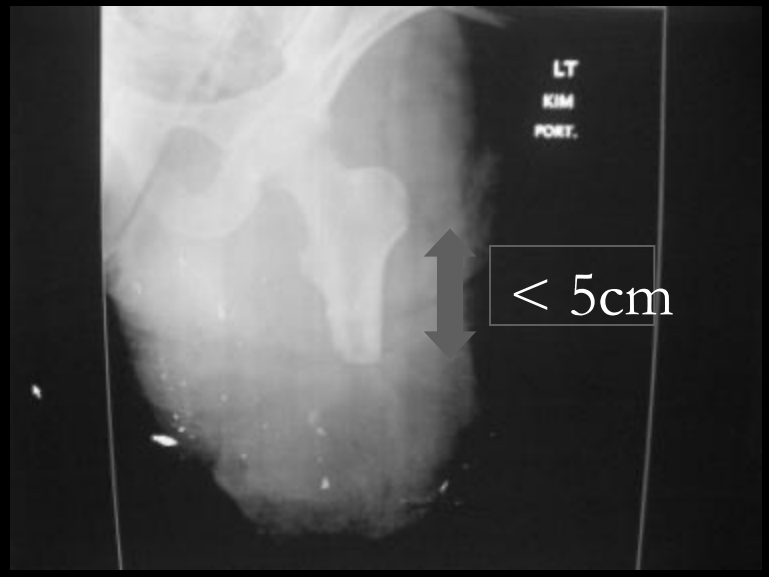




Catagni, M.A. : Atlas for the Insertion of Transosseous Wires and Half-pins, *ILIZAROV METHOD*; Milan, Italy, Medi Surgical Video 2003; pp 1-50

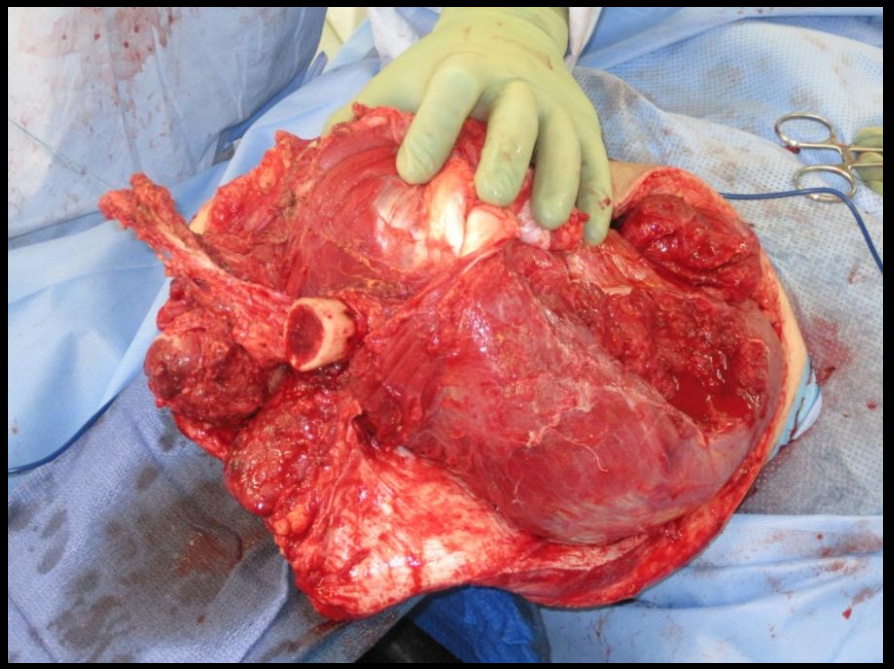
Segmental loss of his femoral artery / bone and near circumferential disruption of his soft tissues




LT
KIM
PORT.
< 5cm

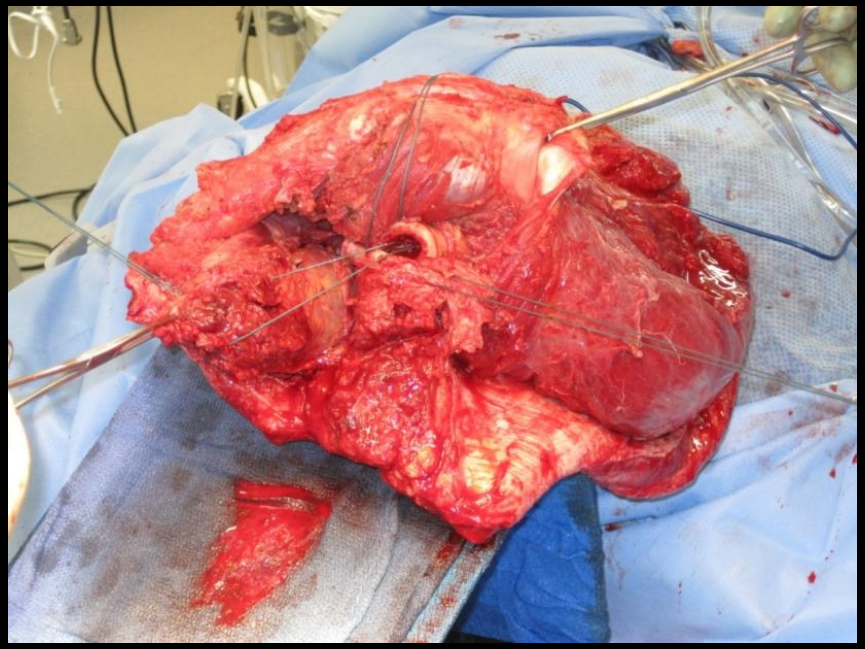
Transfemoral Amputation

- Adductor myodesis
- Tension with hip extended and adducted

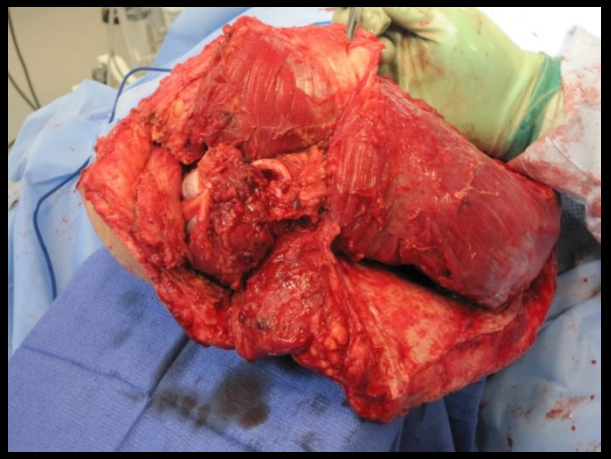


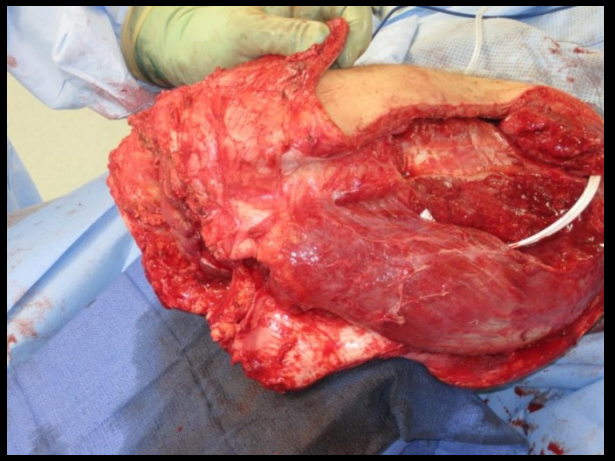
Transfemoral Amputation

Medial hamstring myodesis



Quadriceps myoplasty





Transfemoral Positioning

Worry - Hip Flexion Contracture

Post-Op Prevention

- Leg Flat on Bed
- Not Elevated
- Early Proning

Post-Operative Amputation Dressings

Partial Foot, Syme, Transtibial, and Knee Disarticulation:

Rigid Dressing - Avoids Knee Contractures, Protects the End of the Amputation, Documented Less Pain, Ability to Facilitate Rehabilitation

Soft Dressings - Pain Response is for the Patient to Hold the Leg With Knee and Hip Flexion, This Can Cause Contractures. If ACE Bandages Are Applied Poorly, They Can Cause Congestion, Edema, and Wound Problems

Use of tape prevents rolling down/tourniquet effect

Removable Splints - Very Useful for Open Wounds, STSG, Post-operative Amputation Infections. The Splint Needs to Hold the Knee in Extension, and Protect the Distal End of the Amputation

Post-Operative Amputation Dressings

Transfemoral and Hip Disarticulation Levels

Rigid Dressing Techniques Are Available and While They Facilitate Standing and Walking They Can Make Sitting, Transfers and Toilet Activity Very Difficult

Shrinker Socks With Waistband or
Spica ACE Wrap Work Well

Avoid the Middle of the Night,
Isolated AKA Wrap That Puts
"An Extra Turn at the Top to Keep It On"

Post-op Amputee (Phase 1, week 1)

- Physio
  - Bed-to-wheelchair mobility
  - ROM exercises
  - Edema control
  - Independent gait training with walker/crutches
  - Transition to outpatient
- Wound management
  - Dressing changes prn
  - Keep wound dry and protected with dressing
  - Remove drains if used

Post-op Amputee (Phase 2, weeks 2-10)

- Physio
  - Independent exercise
    - Strengthening
    - Core stability/lumbar stabilization
    - Balance
    - Cardiovascular training
  - ROM exercises for optimal prosthetic use
  - Independent mobility
- Wound management
  - Sutures/staples removed (3+ weeks)
  - Shrinker/compression sock initiated when wounds dry
  - Transition to liner

Post-op Amputee (Phase 3, weeks 11+)

- Rehabilitation goals
  - Weight-bearing and weight-shifting activities
  - Independent rehabilitation
  - Normalization of gait
    - Wean from assistive devices
  - Return to organized and individual sport
  - Return to vocation-specific training

Many Amputees Prefer Non-Impact Sports and Activities

Although Running and Impact Sports Are Possible

Many Choose Other Activities because of the Discomfort and Sores that Can Result from Repeated Impact

Employment, Sports, and Recreational Activities

- LEAP Study Group Data at 7 years
  - 58% of 423 patients had returned to work
    - 47% of amputees
    - 62% of limb salvage

NO DIFFERENCE

  - Those who returned to work
    - limited in their ability to perform their job up to 25% of the time

Mackenzie EJ, Bosse MJ, Pollak AN, et al. Early predictors of long-term work disability after major limb trauma. J Trauma 2006;61(3):688–94.

Employment, Sports, and Recreational Activities

Never Say Never

-

You Will Be Proved Wrong

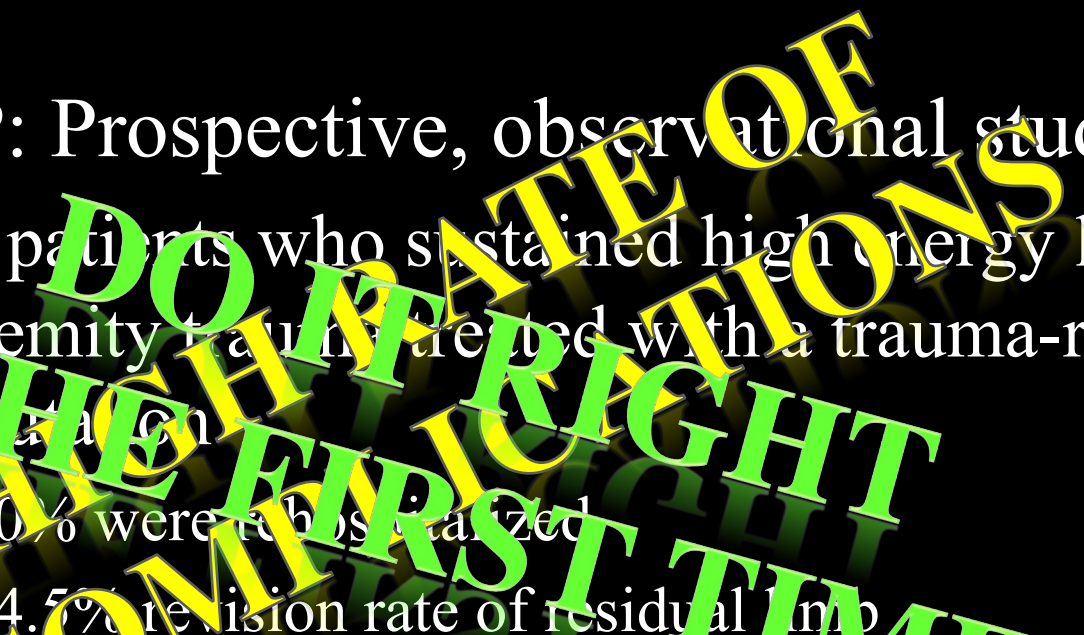
Military Experience → 16.5%
Return to Duty Rate

Stinner DJ, Burns TC, Kirk KL, et al.: Return to Duty Rate of Amputee Soldiers in the Current Conflicts in Afghanistan and Iraq. *J Trauma*. 2010;68(6):1476-9.

Best Available Evidence

- LEAP: Prospective, observational study
  - 149 patients who sustained high energy lower extremity trauma treated with a trauma-related amputation
    - 70% were rehospitalized
    - 14.5% revision rate of residual limb
    - Nearly half with wound necrosis or infection

DO IT RIGHT THE FIRST TIME



Harris AM, Althausen PL, Kellam J, et al. Complications following limb-threatening lower extremity trauma. *J Orthop Trauma*. 2009;23:1-6.

Questions/Comments?

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