

Limb Salvage versus Amputation



Joanie Santucci, RN, MN, OCNS-C
Trauma Orthopedics/Limb Viability
Harborview Medical Center



Objectives

- Limb salvage or amputation
 - Decision making tools & concepts
 - Outcomes
- Amputee populations
- Postoperative amputation issues
- Resources for recovery



Musculoskeletal Injury

- Incidence in U.S.
 - 28.6 million/year
 - 2/3 of all injuries are to the M/S system
 - 25 million ER visits/year
 - >3 million hospitalizations/year
 - 1 of 2 women, 1 of 8 men older than 50 will have an osteoporosis-related fracture in their lifetime
 - Sprains, dislocations, fractures = 65% of all M/S injuries

Initial Management

- ATLS
- Resuscitation goals
 - ABCD
 - Extremity injuries secondary
 - Life over limb
- On-going multisystem assessment



ATLS (ortho) Guidelines

- Prompt hemorrhage control
- Early fracture stabilization
- Timely management of significant tissue defects



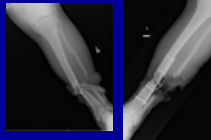
Life Threatening Injuries

- Pelvic fractures
- Crush injuries
- Open severe contaminated fractures
- Necrotizing soft tissue infections



Major Multi-Trauma

- "Damage control surgery" (staged surgery)
 - Extended surgical procedures can increase risk of ARDS, MODS, SIRS
 - Balance with early fracture fixation that decreases morbidity and mortality
 - Multiple surgical teams in OR
 - "Washout", amputation if life-saving
 - Fixator pins: restore length, align bone fractures and joints, enable wound care in ICU, decompress muscle compartments
- 24-48 hours post injury
 - I&D
 - Definitive fixation
- Day 5-10 post injury
 - Reconstruction of intra-articular fractures



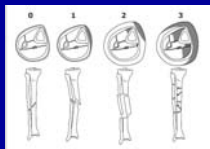
Limb Threatening Injuries

- Fracture dislocations
- Fracture with vascular &/or nerve injury
- Severe soft tissue loss
- Open severe contaminated fractures
- Compartment syndrome
- Limb ischemia/crush



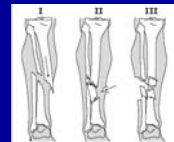
Closed Fracture (Tscherne classification)

Type	Description
0	Minimal soft-tissue damage. Indirect violence. Simple fracture patterns. Example: torsion fracture of the tibia in skiers.
1	Superficial abrasion or contusion caused by pressure from within. Mild to moderately severe fracture configuration. Example: pronation fracture-dislocation of the ankle joint with soft-tissue lesion over the medial malleolus.
2	Deep contaminated abrasion associated with localised skin or muscle contusion. Impending compartment syndrome. Severe fracture configuration. Example: segmental "bumper" fracture of the tibia.
3	Extensive skin contusion or crush. Underlying muscle damage may be severe. Subcutaneous decollement. Decompensated compartment syndrome. Associated major vascular and/or nerve injury. Severe or comminuted fracture configuration.



Open Fracture (Gustilo classification)

Grade	Description
I	A fracture with a clean cutaneous wound less than 5 cm in length.
II	A fracture with laceration greater than 5 cm in length lacking any severe soft-tissue damage.
III	A fracture with extensive soft-tissue damage and ...
A	... adequate coverage of the fracture by soft tissues despite extensive cutaneous lacerations or flaps. High-energy trauma irrespective of wound size.
B	... more extensive injury to and contamination of the soft tissues, periosteal stripping and soft-tissue gaps are present.
C	... any open fracture with an arterial injury requiring repair regardless of degree of soft tissue disruption.



Mangled Extremity Severity Score (MESS)

- Tool that assists in decision making
 - **Skeletal and soft tissue injury**
 - 1=Low energy, simple fx; 2=moderate energy, open/dislocated; 3=high energy, MVC, rifle; 4= very high energy, gross contamination, multitrauma
 - **Limb ischemia**
 - 1=pulse/sensation+; 2=no pulse, numb; 3=cool, paralyzed; 4=>6hr ischemia (score x 2)
 - **Shock**
 - 0=SBP>90; 1= transient hypotension; 2=persistent hypotension
 - **Age**
 - 0=<30; 1=30-50; 2=>50



Amputation Criteria

- Absolute
 - Non-reconstructable vascular injury
 - Severe bone & soft tissue loss with PTN disruption
- Relative
 - Shock and elderly with mangled limb
 - Massive muscle loss associated with bone loss
 - MESS > 7, especially with no plantar sensation
- Urgent
 - Associated injuries
 - Multisystem organ failure



Case example: muscle/skin loss, associated injuries, vessel injury

- 45 y.o. male, MVC, pole falling on top of car. + LOC. OSH: R pneumothorax, pulseless RUE with degloving injury to R shoulder, R 1-2 rib fxs, R humerus & radius/ulna fxs
- Transferred to HMC: angio = occlusion of R brachial artery. Emergent OR for exploration of RUE wounds, repair of brachial artery, fixation of UE fractures
- Multiple I & Ds, progressive skin loss of humeral area & BPG

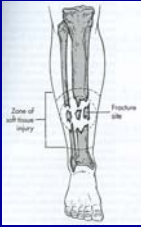


Case example: muscle/skin loss, associated injuries, vessel injury

- 3 weeks later nursing staff noted bleeding (in VAC), exsanguinating hemorrhage in vicinity of axillary-brachial graft, attempt to re-do graft which resulted in extensive bleeding, graft ligated.
- Developed extensive claudication pain of RUE, forearm obviously dead clinically & to gross observation. I&D notable for green purulence
- Counseling regarding options of care
- Definitive R shoulder disarticulation & excision of residual infected BPG
- "My recovery began when my arm came off"



Soft Tissue Defects



Zone of soft tissue injury generally larger than the area of the fracture



Soft Tissue Defect (salvage)

- 35 y.o. female at a party with boyfriend who got in a fight with ex-husband. Accidental firing of .22 gauge rifle, GSW right foot with entry wound on dorsum, exit plantar. Multiple open MT & cuneiform fxs.
- Serial I&Ds, time for soft tissue to demarcate, DVT prophylaxis. Foot in equinus; cannot tolerate pressure on plantar aspect to remain in neutral. Mottling 4th toe & dorsum, expect eschar on dorsum
- Recs: contracture prevention, stop smoking, rehab psych for anxiety, DVT prophylaxis
- DC: wound care, PT, splint, NWB
- Long and uncertain course



Reviewing Goals in Salvage

- Is this going in the right direction?
- Evaluate at
 - 3 months
 - 6 months
 - 12 months
- Salvage does not = normal



Soft Tissue Defect (amputation)

- 47 y.o. male slipped off roof, fell 8 ft, foot struck railroad tie. L tibial pilon fx, lateral malleolus fx, tendon tears. DM, HTN. Retired army ranger.
- Treatment: ORIF malleolus, spanning external fixator across ankle, tendon repairs. Definitive fixation delayed 2/2 swelling. Poor glucose control.



ST Defect case (cont.)

- Readmission 1 month later for definitive fixation. In OR, noted no healing/separation along lateral wound, drainage, erythema. Fixation deferred. Wound healing poor, exposed hardware.
- 1 month later: complete dehiscence of lateral wound with visible HW & bone. Foot significantly swollen & nonfunctional.
- Given chronic infection, poor wound healing, dysfunctional foot, BKA recommended. Pt felt that amputation was best route of care & procedure performed. BKA protocol.

Limb Salvage vs. Amputation

- Difficult decision for patient & team
 - Limb Viability Service consult
 - Multidisciplinary approach
 - Patient is the 'owner'
- Information to patient
 - Multiple surgeries, risks
 - Expected function
 - Time to weight bear
 - Ability to change plans
- Information about patient
 - Lifestyle
 - Concerns, fears
 - Goals



Who is our ortho trauma patient?

Pts with high-energy lower extremity trauma (LEAP)

- Male (77%)
- White (72%)
- 24-45 years (71%)
- 70% graduated from high school (86% nationally)
- 25% with incomes below poverty level (16% nationally)
- 38% no health insurance (20% nationally)
- % of heavy drinkers twice the national average
- More neurotic & extroverted, less open to new experiences

Life-altering Outcomes

- Multiple hospitalizations & surgeries, loss of limb(s)
- Functional problems following orthopedic trauma
 - LE injury sustained in MVC (CIREN data) 1 year post injury:
 - 46% reported limitations in walking
 - 22% with ankle/foot fractures unable to return to work
 - 39% depression, 32% cognitive problems, 18% PTSD
- Emotional distress
 - Connection b/w physical injury /disability/emotional distress
 - Pain predicts: physical/mental health status, return to work
 - PTSD, depression, anxiety, pain: frequent & disabling factors
 - Pain at 3 months/ ICU stay/ depression = predictive of pain at 1 year

Amputation vs. Salvage Outcomes

LEAP study

- **No difference in functional outcome** b/w pts who had either limb salvage surgery or amputation at 2- and 7- year follow-ups
- Outcomes on average were **poor** for both groups
- **Wide-ranging variations** in outcome following major limb trauma
- Large portion of patients experience **long-term disability**
- Outcomes affected by pt's **economic, social, and personal resources** than by the initial treatment of the injury (salvage or level of amputation)
 - Low educational level
 - Nonwhite
 - Poverty
 - Lack of private health insurance
 - Smoking
 - Disability compensation litigation
- Differences b/w civilian and military populations

Amputation should not be thought of as a failure of treatment, but rather a treatment of choice



Limb Viability Service

- Multidisciplinary consult team at HMC
 - MDs (attendings): Orthopaedics, General Surgery, Physical Medicine/Rehabilitation, Podiatry, Vascular Surgery
 - RNs: Ortho CNS/team coordinator, Wound CNS, Ortho ARNP, Vascular ARNP
 - Pharmacist
 - PT
 - OT
 - Prosthetist
- Consultation and coordinated care for those with severe extremity trauma or threatened limbs due to disease
 - Surgical/treatment recommendations
 - Counseling/education
 - Rehabilitation/mobility



Upper Extremity



- Non-weight bearing
- Can function with decreased sensation
- Assistive upper limb often functions better than prosthesis
- Decision to salvage:
 - Technical possibility
 - Chance of maintaining some useful function

Lower Extremity



- Weight bearing mandatory
- Functions very poorly with decreased sensation
- Modern prosthesis often better than salvaged limb
- Decision to salvage:
 - Based on providing a limb that can tolerate weight bearing
 - Have some protective sensation
 - Have durable skin and soft tissue

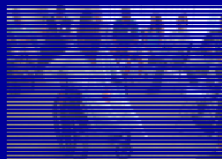
Limb Loss in the U.S.

- Estimated at 1.5 million persons
- Majority are lower extremities
- Rates of cancer & trauma-related amputations decreasing
- Rates of dysvascular amputations rising
- HMC population not reflective of national data
 - Higher trauma-related causes
 - Seasonal trends



Amputee Population

- Diabetic/Dysvascular
 - Amputation 10-30 times more likely
 - 50% contralateral amputation within 3-5 years
 - Mortality post-amputation
 - 13-40% at 1 year
 - 35-65% at 3 years
 - 39-80% at 5 years
- Patients experience decline



Amputee Population (cont.)

- Trauma-related
 - Young & healthy
 - Machinery, power tools, MVC/MCC
 - Aggressive about saving length
 - Multiple surgeries, salvage attempts
 - Amputation often a life-saving event
 - Decision of life over limb
 - Person unaware initially



Amputee Population (cont.)

- Elective/planned amputations
 - ‘Failed’ salvage
 - Infections
 - Pain
 - Immobility
 - Depression
 - Financial hardship
 - “I want my life back”



Amputee Population (cont.)

- Military
 - Body armor protects torso, not extremities
 - Explosive devices: complex wounds, extensive soft tissue damage, multiple extremity injuries & amputations, TBIs
 - Staged surgical approaches
 - Amputee research & rehabilitation now a priority
 - Not necessarily career ending



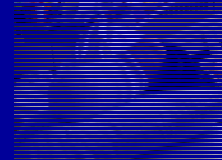
Post Surgical Residual Limb Changes

- Edema from severed muscles
- Shrinkage from muscle atrophy and subcutaneous fat decrease
- Transected bone changes
- Neuroma formation



Soft Tissue Edema Control and Protection

- Soft dressings
 - Net dressings
- Compression wraps
 - Shrinker socks
 - ⊗ access to wound care
 - ⊗ poor edema & pain control, unpredictable pressure with ace wraps, ineffective contracture prevention



Soft Tissue Edema Control and Protection (cont.)

- Rigid dressings/casts
 - ⊗ edema control, ↓ pain, prevents contractures, good protection
 - ⊗ no easy access, skill to apply, not for AKA or UE



Soft Tissue Edema Control and Protection (cont.)

- Splints
 - ⊗ wound access, protects, prevents contractures, light weight
 - ⊗ Not custom fit, or custom splint no longer fits, minimal protection during fall



Soft Tissue Edema Control and Protection (cont.)

- Immediate post-op prosthesis (IPOP)
 - ⊙ early weight bearing for BKA, offers psychological benefit
 - ⊙ difficult to judge weight bearing, requires balance & strength, fall risk?



Mobility Issues

- Contracture prevention
 - Knee splints for extension (BKA)
 - Prone positioning daily for hip extension (AKA)
 - Shoulder ROM (AEA)
 - Supination/pronation (BEA)
- Strengthening & endurance building
 - Energy expenditure increases with more proximal level & multiple amputation levels
 - PT/OT protocols for specific amputations
 - Upper body, back, lower extremities
- Fall prevention strategies



“A journey of a thousand miles must begin with a single step” – Lao-tzu

Mobility Issues (cont.)

- Energy expenditure
 - Unilateral vs. bilateral
 - Vascular vs. traumatic
 - Length of residual limb
 - Prosthetic components
 - Cardiovascular state
 - Age
 - Physical fitness
 - Walking speed



Metabolic Costs

Percentage > normal

- Unilateral BKA: 25%
- Unilateral AKA: 40%
- Dysvascular BKA: 40%
- Dysvascular AKA: 100%



Pain Management

- Phantom pain (pain in missing limb)
 - Varied descriptions: crush, stab, shock
 - Expected to decrease over time, severe long-term problems exceptional
 - Gabapentin (Neurontin) typically started at 300 mg @HS, titrated up (TID, increased dose)
 - Long-acting opiate useful
 - Many non-drug treatments useful: massage opposite limb, distraction, repositioning, touch
- Phantom sensations (non-painful feeling in missing part)
- Experienced by majority of amputees



Emotional Adjustments to Limb Loss

- Loss: the end or change of a familiar pattern of living or behavior
 - Work potential, occupation
 - Relationships
 - Perception of self
 - Role in family
 - Social activities, recreation



Emotional Recovery

- Responses
 - Grief is a natural reaction to loss
 - Reactions vary, no universal response
 - Ethnic variations in expressions of pain, loss, grief
 - Stages of recovery not orderly
 - Caregivers: helplessness, despair, guilt, overwhelming responsibility, loss of personal freedom, depression



Factors that Enhance Adaptation

- Positive body image
- Optimism
- Reframing of life meaning
- Perceived control
- Active problem-solving
- Social support and interaction



What We Can Do

- Recognize the need to make meaning
 - What are your concerns or fears?
 - What do you hate the most?
 - What things are OK with you?
 - Where do you get your strength?
- Presence, 'be with' rather than 'fix'
- Offer a sense of hope, trust, optimism
 - Goals
 - Recovery is a process
- Support the family



What is Recovery?

- Sense of balance in emotions and social relationships
- Awareness of abilities and limitations
- Positive self-concept and sense of personal mastery
- Ability to get around in social and physical environments
- Participates in social, vocational, recreational activities
- Identifies priorities



Resources for Recovery

- Strong, significant personal relationships
- Social support outside of family
 - Amputee support groups
 - Amputee peer visitors
- Advocacy and Information
 - Amputee Coalition of America (ACA)
- Spiritual support
- Counselor familiar with amputee issues



HMC Amputee Support Group

Benefits of "group"

- Interaction with other amputees, not alone
- Safe place, understanding & acceptance
- Specific feedback, advice, information
- Acknowledge efforts, strengths, contributions
- Encourage self-observation
- Support for family
- Ways to cope in everyday life
- Information exchange, networking



Prosthetic Advancements



"No technology will ever replace the willpower and mental stamina required over months to hone an altered body into peak condition"

Surgical Advancements

- Targeted Muscle Reinnervation
 - Amputated nerves at time of injury are transferred to intact motor nerves still present in residual limb
 - Sensor in prosthesis picks up signal that formerly was sent to forearm prosthetic arm
 - Prosthesis use becomes intuitive, allowing simultaneous control of the hand and elbow
 - Improve functional ability of AEA & shoulder disarticulations



Employment



Sports/Recreation as Rehabilitation



Competition as Rehabilitation



Amputees in the Media





"Fortunately, the vast majority of individuals find the magical and magnificent inner strength to rise above adversity." – Doug Smith, MD