Transtibial Amputation Update

R. Bruce Simpson MD
Hughston Trauma
Ft Walton Beach, FL

Objectives

- Review relevant anatomy for transtibial ambutations
- Discuss methods of performing transtibial amputations
- Tricks and traps

Amputation – History of Violence

- ***Amputare*** lat. – *"to cut away"*
- Described since antiquity as a form of punishment, medical treatment
  - Sumerian codex (c. 3000 BC)
  - Temple of Ramses II (13th century BC)

Historical Review
Middle Ages

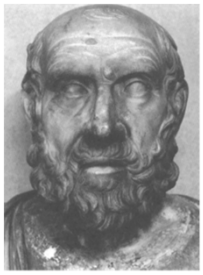
- Importance in speed
- Secondary healing
- Poor functional expectations

Hippocrates
400 b.c.e.

- Advice to young surgeons
- "…join and follow an army…"

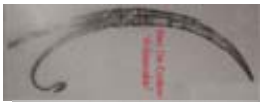
Hippocrates
Principles of Wound Management

- Remove devitalized tissue
- Cleanse remaining tissues
- Application of bacteriostatic (copper) material



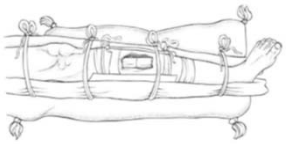
Ambrose Pare 1561: Initiation of Modern Treatment

- Splintage (immobilization)
- Astringent dressings
- Ligature of vessels



Percival Pott 1756

- Open tibial fracture
- Gross contamination
- (Personal experience): demanded limb salvage



Surgical Management of Open Fractures Pre-anesthetic Era

- Lack of time to perform careful dissection and control bleeding
- No concept of Germ theory of disease
- 30% Fatality

Major Indications

- Dysvascular
  - Ischemia
  - Infection
  - Diabetes – 71% of cases
- Congenital
  - Account for most pediatric amputation
    - Fubular hemimelia, amniotic band syndrome, purpura fulminans…
- Malignancy
- ***TRAUMA***
  - ***Motor Vehicle***
  - ***War Injury***
    - In third world country hazards such as land mines account for 40 – 70 %[ex] of pediatric amputation
- Other
  - Frostbite, Charcot Arthropathy, CRPS

Traumatic Amputation

- Priorities:
  - Exam/resuscitation (ATLS)
  - Realign extremities/splint immobilization
  - Wound decontamination/dressings
  - Soft tissue management

Decision-making

- Document
- Document
- Document

MESS Score
Predictive Value

Helfet *CORR* **256** 1990

- Combined MESS score > 7 successfully predicted those patients who would undergo secondary or salvage amputation
- Our recent patient: 2+1+3+4 = 14

Limb Salvage Surgery

- Readiness of the patient:
  - Resuscitation
- Readiness of the facility
  - OR access
  - Blood availability
  - Team
- Surgical team:
  - Experience

Traumatic Amputation

Goal:

- Produce a viab
  end-bearing
  residual limb
- Pain-free
- Stable
- Durable

Principles of Traumatic Amputation

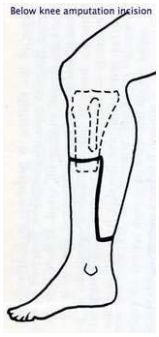
- Optimize function of residual limb
- Maximize patient mobility and independence
- Thorough debridement of all contaminated wounds
  - All devitalized muscle, skin, and bone must be excised
  - Save any and all viable tissue to use in definitive closure
- Expedient decision-making
  - Later amputation associated with higher complication [2]
- Length preservation

Timing of Amputation

- **Primary (1-72 hrs) (DCO)**
- Minimize burden of devitalized tissue
- Control bleeding
- Definitive: 3-5 days
  - Confirm limit of injury
  - Margin of viability
  - 4 C's:
    - Color
    - Contractility
    - Consistency
    - Capacity to bleed

Technique

- Long posterior flap
- 12-17 cm bone cuts
- Preserve muscle units
- Isolate nerves
  - Tibial
  - Peroneals
  - Saphenous

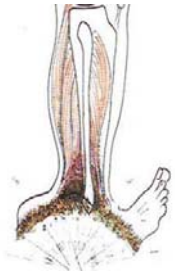


Technique

- Tibial length
  - 12-17 cm
- Fibula
  - 2cm short
- Match length of bone to available soft tissue
- Myoplasty
  - Anterior
  - Posterior
  - Lateral

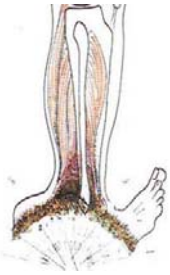
Technique
Asymmetric Flaps

- Use what you have
  - Tissue is sacred
- Keep the goals focused:
  - Balanced agonist/antagonists
  - Abundant soft tissue padding
  - Well-mitered bone cuts



The Mangled Extremity

- High energy missile injury: pathomechanisms differ
  - High velocity missile
  - Low velocity (high energy) missile
- Blast injury
- Crush
- Avulsion (partial)



Why save length?

Energy cost of walking of amputees: the influence of level of amputation

RL Waters, J Perry, D Antonelli and H Hislop
J Bone Joint Surg Am. 1976;58:42-46.

- Classic article on energy cost
- 50 normal ambulators vs. 70 amputees
  - Symes, BKA, AKA (also split vasc. & trauma)
  - Inclusion – no stump pain, swelling, pressure sore, wearing prostheses > 6mo
- 60 m track – 3min warmup,2min testing

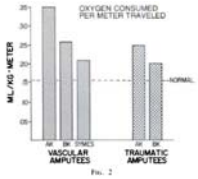
- Conclusions
  - Higher amputation correlated with decreased walking speed
  - All groups adjusted walking speed to keep energy expenditure within normal limits *
  - Crutch walking without prosthesis resulted in increased energy cost in all groups

*except Vascular AKA

Energy Cost

Group		Relative Energy Cost
Norm		38%
Vasc	Syme	43%
	BKA	42%
	AKA	63%
Trauma	BKA	35%
	AKA	35%

Adapted from Waters et al.



Significance
- Proposed that amputees adjust rate of walking to expend normal energy levels
- O2 consumed per meter traveled
  - AKA – 33 % increase
  - BKA – 25% increase

Caution

- Interpreting old O2 ustilization data in the setting of new technology
- Believing that patients will be "normal" with expensive devices
- Advise patients there will be more surgeries

Ertl Osteomyoplasty

- Create a tibio-fibular synostosis
- "Restore intraosseous pressure"
  - Improve viability of the limb
- Careful muscle balancing

Ertl Osteomyoplasty

- Periosteal sleeve
  - Anterior/posterior tibia
  - Bone graft
- Tibial notch
- Fibular bridge
  - 5-7 cm long
  - Preserve the lateral periosteum
- Anterior/posterior muscle balancing
- Incorporate lateral muscles

Traps

- Unstable proximal tib-fib joint
  - Scissoring
- Poor myodesis
  - Incorrect muscle tension
- Bone too long/inadequate soft tissue
- Neuromas
- Pseudoaneurism

Poor Outcomes

- Pain -
  - Back Pain
  - Phantom limb pain
  - Neuromas
  - Heterotopic growth/spurs
  - Asymetric atrophy

Summary

- Careful attention to anatomy
- Isolate vessels and nerves
- Balanced myodesis
- Be ready for multiple revisions