Amputations of the Foot and Ankle

AOFAS Resident Review Course
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Disclosure

- Consultant for Biomimetics
Foot Salvage / Partial Amputations

- **CORE PRINCIPLES**

- **Major Goals** –
  - Attempt to **AVOID** Transtibial Amputation (TTA)
  - Achievement of **COMPLETE** healing with a **STABLE** soft tissue envelope
  - **PLANTIGRADE, BALANCED** functional foot
Amputations - Etiologies

- Peripheral Vascular Disease
- Trauma
- Chronic Infection
- Tumors
- Congenital Abnormalities
- Diabetes
Diabetes Statistics

- **Leading Cause of:**
  - Blindness
  - Heart Disease
  - Vascular Disease
  - End-Stage Renal Disease

- **Lower Limb Amputation – Transtibial** (67,000 yr)
  - 30%-50% lose other limb within 3-5 years (Friel, JAAOS 2005)
  - 2/3 diabetics die within 5 years
Diabetic Foot Problems

- Peripheral Neuropathy
  - Stocking / (glove)
  - Loss of protective sensation, 5.07 MF
- Neuropathic Ulceration
- Infection
  - Cellulitis
  - Abscess
  - Osteomyelitis
- Charcot Neuropathic Arthropathy
Foot Salvage / Partial Amputations

- LEARNING OBJECTIVES
Learning Objectives

- Review foot/ankle anatomy relevant to amputations
- Identify and understand **factors** that lead to **Optimal level of amputation**
Learning Objectives

- Describe and understand **surgical techniques**
  - Potential complications *(OITE)*

- Understand and apply appropriate **post operative management** principles
  - Shoe modifications, orthoses, prostheses *(OITE)*

- Learn **expected outcomes** of partial foot amputations
Optimal Level of Amputation

FACTORS

- Bone and Joint Anatomy
- Soft Tissue Viability and Durability
  - Blood Supply
- Soft Tissue Balancing
- Save Length
Bone and Joint Anatomy

Bones

Joints

Tendon Insertions
Joint Disarticulations - Mid Osseous

- Syme
- Chopart
- Lisfranc
- Transmetatarsal
- Metatarsal-Phalangeal
- Toe amp or disarticulation
Soft Tissue Viability / Durability Biology

• Blood Supply
  • TcPO2 >30 mmHG (OITE 2006)
  • ABI
    • >0.45 diabetics
    • >0.35 trauma
  • Beware non-compressible vessels
  • Absolute toe pressure >45 mmHG (OITE 2002)
Soft Tissue Viability / Durability

Biology

• Blood Supply
  • TcPO2 >30 mmHG (OITE 2006)
  • ABI
    • >0.45 diabetics
    • >0.35 trauma
  • Beware non-compressible vessels
  • Absolute toe pressure >45 mmHG (OITE 2002)

• Nutrition
  • Abs lymphocyte count>1500mm3
  • Albumin > 3.5 g/dl (OITE 2004)
Soft Tissue Balancing

- **Dorsiflexion**
  - Tibialis Anterior
  - Tibialis Posterior
  - Gastroc-Soleus

- **Plantarflexion**

- **Varus**

- **Valgus**

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Extremity Length

- When soft tissue envelope allows....
  - PRESERVE LENGTH
  - Oxygen consumed per meter traveled (ml/kg – meter)

- AKA > BKA > Symes/Chopart
  - Vascular Amputees
    - AKA: 100% more
    - BKA: 60%
    - Syme/: 30%
    - Chopart
  - Traumatic
    - AKA: 60% more
    - BKA: 30%
    - Syme/: 10%
    - Chopart

- Strive For..........
Extremity Length

- **Strive For –**
  - Preserved length

- **But - Remove enough bone.....**
  - Primary wound closure
  - Avoid STSG
Surgical Techniques - Complications

- MTP / IP joint
- Ray resection
- Transmetatarsal
- Chopart’s
- Calcanectomy
  - Total or partial
- Syme’s
Amputation
MTP or IP joint

- Incisions
  - racquet type
  - Fish mouth
    - Flaps – side to side, or dorsal-PL
    - Bone resection base flaps
- Great Toe
  - Leave 1 cm base prox phalanx
  - Some function / WB preserved
    - PF, FHB
Amputation
Ray Resection

- Border Rays
- Central Rays

- Border Rays do better
- Can function very well
Amputation
Ray Resection

- Border Rays

- Incision
  - Racquet, dorsal and PL flaps
- **Bone resection level**
  - Much more proximal than flaps
- Remember: save all viable tissue

- Plantar ulcer: separate elliptical excision
  - keep open, drain placed
Amputation Complications

- Ray Resection
  - If 3+ rays, take 5 (Transmetatarsal)
  - Improper soft tissue balancing

- Toe drift
- Claw toe
- Recurrent adjacent ulcerations
Amputation
Post op Care

- Ray Resection
  - Ray forefoot filler to avoid shear

- Wide toe, extra depth shoe
- Shoe with steel shank or carbon
  - Extends foot lever
  - Prevents deformity at toe break

(OSAE 2009)
Amputation Transmetatarsal

• Skin incisions key
  - Long plantar flap preferred
  - Bevel plantar aspect
Amputation
Transmetatarsal

- *Bone Resection Level*
  - MT length cascade important
  - Preserve tendon attachments when can. WHEN CANNOT.....

**What Deforming Forces are still attached?**
Amputation Complications

- TRANSMETATARSAL
- Recurrent ulcerations
  - Plantar
    - Cascade problem; or new bone formation
  - Distal edge of stump
    - Equinus contracture
    - Achilles tendon lengthening
  - Lateral skin
    - If peroneus brevis is disrupted, risk varus - lateral skin breakdown
    - Reattach PB when needed, OR lengthen Post Tib
Amputation
Post-Op Care

TMA

Aftercare
• High top shoe / sneaker
• TCI with Forefoot Filler
• Some need locked ankle braces
Amputation Chopart’s

- Disarticulate at TN/CC joints
  - Chopart’s jts
- Skin incisions: dorsal/plantar

- What major tendon Disrupted?
- What Deforming Force is still attached?
Chopart’s Amputation

- Tibialis anterior tendon
- Reattachment required
Choparts Amputation

Tenodesis Tib Ant
• To Talus
• Bone trough - screw
• Or staple
• Preserve active ankle dorsiflexion

Achilles Tendon
Lengthening
• Avoid complication of equinus contracture
  (OITE 2004)
Choparts Amputation

Post op Care

- AFO with Forefoot filler
- Potential for articulated AFO
Total or Partial Calcanectomy

**Indications** *(OSAE 2007, 1998)*

- Chronically infected heel ulcer
- Evidence of osteomyelitis
  - MRI, indium WBC scan
- Satisfactory arterial flow
- Failed nonop treatment
Total or Partial Calcanectomy

- **Indications** *(OSAE 2007, 1998)*

- **Techniques**
  - Partial – tuberosity
  - Total - thru subtalar and CC joints
Total or Partial Calcanectomy

- Advantages – retained foot, no prosthesis
- Complications
  - PF weakness, new foot wounds
  - High failure rates

- Post-Op care –
  - AFO with heel containment orthotic filler
Amputation
Syme’s

- Syme (ankle disarticulation)
  - Remove malleoli
  - Patent posterior tibial artery necessary to heal
  - Heel pad **must be** secured to tibia and extensor tendons
Syme’s Amputation

Complications

- Heel pad migration
- Button-hole posterior calcaneal skin, insufficient wound healing
- Neuroma formation (Trauma)
- Cosmesis not great – “wide ankle”
Syme’s Amputation

- Advantages
  - End bearing, heel pad preserved
  - No auxiliary suspension mechanisms (OITE 2001)
  - Can ambulate without prosthesis

- Post-op care
  - SACH heel / foot
  - PTB AFO

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Partial Foot Amputations

Outcomes VERSUS Transtibial Amputation

- Mortality rate?
- Proximal reamputation rates?
- Ambulatory status?

- University of Rochester experience
  - Partial Foot Amputation in Pts with Diabetic Foot Ulcers
  - Brown, et al, FAI 2012
## Partial Foot Amputations

<table>
<thead>
<tr>
<th></th>
<th>TTA</th>
<th>TMA</th>
<th>Chopart</th>
<th>P Calc</th>
<th>T Calc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients</strong></td>
<td>18</td>
<td>21</td>
<td>10</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td><strong>Deaths</strong></td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td><strong>1-year mortality rate</strong></td>
<td>0.23</td>
<td>0.00*</td>
<td>0.2</td>
<td>0.12</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>3-year mortality</strong></td>
<td>0.30</td>
<td>0.05*</td>
<td>0.3</td>
<td>0.38</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>5-year mortality</strong></td>
<td>0.45</td>
<td>0.3</td>
<td>0.4</td>
<td>0.69</td>
<td>0.59</td>
</tr>
<tr>
<td><strong>Proximal reamps</strong></td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td><strong>Time to proximal reamputation [years]</strong></td>
<td>0.1(_{n=1})</td>
<td>2.3</td>
<td>2.3</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Postoperative ambulatory status</strong></td>
<td>2.8</td>
<td>4.3</td>
<td>4.3</td>
<td>4.3</td>
<td>3.3</td>
</tr>
</tbody>
</table>

1 - Wheelchair, 2 - supervised household, 3 - limited house, 4 - unlimited house, 5 - limited community, 6 - unlimited comm

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* indicates significance.
Partial Foot Amputations

Partial Foot Amputation in Pts with Diabetic Foot Ulcers

• Brown et al, FAI 2012

• Conclusions
  • TTA high M&M; partial foot amps should be investigated
  • Only TMA at 1 and 3 yrs stat significant lower mortality than TTA
    • Other levels no statistically improved survivorship

• TMA and Chopart’s: high ambulatory levels and longest durability --- may provide some ambulatory advantage
  • But potential risk more prox amp, particularly Chopart within 3 yrs
Foot Salvage / Partial Amputations

-- Summary

- Reviewed CORE PRINCIPLES

- Major Goals –
  - Attempt to AVOID transtibial amputations
    - Partial Foot Amps
    - Higher ambulatory levels, some with good durability – LEVEL DEPENDENT
      - But high mortality rates, proximal re-amp rates
  
  - Achievement of COMPLETE healing with STABLE soft tissue envelope

- PLANTIGRADE, BALANCED functional foot
  - Awareness functional anatomy; reattach, lengthen tendons
Thank You

“Up-State Living”

University of Rochester and Medical Center