Amputations of the digit, ray and midfoot

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Treating patients who need an amputation

• “A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty.”

• You must approach amputations with a positive attitude, although there are many reasons to think negatively.
Diabetic related amputations

• “One of the most feared complications of diabetes”: Armstrong Int Wound J 2007

• “A catastrophic complication in individuals with diabetes”: Tseng Gen Hosp Pysch 2007

• More than 60% of non-traumatic amputations occur in patients with diabetes mellitus
Partial foot amputations (PFA)

- Toe disarticulations
- Ray resections
- Transmetatarsal amputations
- Tarsometatarsal amputations
- Midtarsal amputations
• Diabetes
• Soft tissue Infection
• Osteomyelitis
• Ischemia
• All of the above
Goals of PFA

- Plantigrade foot
- Stable wound healing
- Prevent future ulceration
- Provide the ability to use relatively normal shoes with minimal modification
Advantages of PFA

• Preservation of end weight bearing
• May improve proprioception
• Less alteration of body image
• Less energy expenditure ??
• May be able to walk without a prosthesis
Biomechanics of PFA

- Patients walk at 2/3 of normal speed
- Increased ground reaction forces
- Increased plantar pressure
- Residual limb absorbs more of the ground reactive force

Surface area
Ankle Power Generation

- Amputations at or distal to the MTPJ have little effect on ankle power
- Preservation of the metatarsal heads allows the amputee to capitalize on the ankle’s contribution to gait

Ankle Power Generation

- Amputations proximal to the metatarsal heads compromise ankle power
- Hip becomes the main provider of power
- Primary goals of these amputations should be to obtain soft tissue coverage
- May want to consider an above ankle orthotic for these patients.
Ideal prosthetic/orthotic

• Offloading of sensitive areas
• Redistribute pressures
• Provide coupling between foot and device
• Provide sufficient rigidity to allow center of pressure to move beyond residual limb
Increased Energy Expenditure

Waters et al. JBJS 1976
Oxygen consumption (ml/kg/hr)

- Partial foot amputation
  - Chopart
  - Pirogoff
  - Lisfranc
- Surprised to see that BKA had lower energy expenditure than PFA
- Studied traumatic amputees

Prosthetics and orthotics int. 2010
Key Points

• Determine correct level of amputation
• Tissue oxygen perfusion must be adequate for healing
  – Toe pressure of 40mm Hg or greater
• Nutritional status must be addressed
  – Serum albumin and total lymphocyte count
• Perioperative glucose control
Surgical Considerations

• Tourniquet or no tourniquet?
• Aggressive debridement of infection and necrosis
• Conservative debridement of skin flaps for later use
Surgical Considerations

• Closure
  – Use good judgement
  – Clean and granulating
  – Delayed primary closure
  – Negative pressure wound therapy
  – Skin grafting
  – Alternative products
Great toe

- Amputate as distal as possible
- When possible retain the base of the proximal phalanx
  - Aids in standing balance
  - Preservation of windlass mechanism
MTPJ Disarticulation

- Remove medial and lateral sesamoids
- Remove plantar plate
- May need to resect crista
Lesser Toe Amputations

• Removal of distal phalanx is ideal
• Disarticulation at 2\textsuperscript{nd} MTPJ
  – Creates secondary problem
  – Iatrogenic hallux valgus
  – To avoid this consider a proximal ray resection
Ray Amputation

- Excision of a toe and part of the metatarsal
- Single amputation of 2\textsuperscript{nd}, 3\textsuperscript{rd}, and 4\textsuperscript{th} rays do well
- Avoid removal of two or more central rays
  - Poor functional and cosmetic result
1st Ray Amputation

- Preserve as much length of the metatarsal as possible
  - Preserves the medial longitudinal arch
  - Bevel the plantar aspect
- In some cases it may be prudent to perform a transmetatarsal amp
1st Ray Resections

- Major removal of the metatarsal
  - Affects foot function
  - Causes transfer lesions
  - Outcome related to residual length
Transmetatarsal Amputations

• Consider when two or more medial rays are involved or first ray
• Save as much soft tissue as possible
• Preserve parabola
• Consider Achilles tendon lengthening
• Maintain Lisfranc ligament
TMA Functional Outcome

- 80% achieve satisfactory outcome
- Stiff rocker sole prevents distal ulcers
- Distal shoe filler allows a longer forefoot lever
Tarsometatarsal Amputations

- Results in a major loss of forefoot lever
- Prone to equinus
- Must preserve the vital tendons for best results
  - Peroneus brevis
  - Peroneus longus
  - Tibialis anterior
Lisfranc Amputation

- Inherently disrupts the blood supply
Midtarsal Amputation (Chopart’s)

• Through the talonavicular and calcaneocuboid joints
Chopart’s Amputation

- Equinus contracture is the major drawback
- Must lengthen Achilles tendon
- Must reattach the tibialis anterior tendon
- The patient *may* be able to walk short distances
Partial Foot Amputation Healing

Tc PO2

Healed | Delayed Healing | Failure to Heal
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40 | 30 | 20

Tc PO2

PMR Sept 2010: Mayo Clinic
Summary

- Minor amputations have better self-reported quality of life than major amputations.
- Preservation of the metatarsal head maintains near normal kinematics.
- Amputations proximal to Lisfranc joint may not be energy efficient compared to below knee amputation.
Type II DM in adolescents is alarming
Michelangelo’s David
After a 2 year tour in the US
Questions?