Upper Extremity Amputation

Gennadiy Busel, MD
Joao Panattoni, MD
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Amputation: Etiology

- Trauma (most common)
- Vascular Disease
- Malignancy
- Infection

Etiology: Trauma

- >80% of UE Amputation
- Male:Female = 4:1
- Most Amputations at level of Digit
- Major Limb Amputations less common – 3-15% of all amputations
Principles of UE Amputation

- Functional outcomes of amputation are drastically inferior in UE vs LE

- All efforts should be made to salvage the UE or parts to preserve function

- Consider replantation whenever possible

Replantation

- Absolute Indication for Replantation
  - Thumb
  - Multiple Digits
  - Partial Hand
  - Wrist or Forearm
  - Almost any part in a child

Order of Repair

Barbary et al, reviewed surgical technique and order of structures repaired during replantation

1. Bone
2. Flexors
3. Nerves
4. Arteries
5. Extensors
6. Veins
7. Skin

Order of Repair

Order of finger replant:
• 1) Thumb 2) Long 3) Ring 4) Small 5) Index

• For multiple amputated digits structure-by-structure repair is quicker than digit-by-digit repair

• Salvage of thumb for opposition/grip is most important

• If not possible to replant, consider:
  – Ectopic replantation (severe contamination, unstable patient)
  – Cross limb/digit replantation
  – Spare parts (bone, tendon, nerve, skin, filet flap)
  – Preserve as much length as possible
  – Functional outcome
Contraindications to Replantation

- Severely crushed or mangled parts
- Multiple levels
- Other serious injuries or diseases
- Prolonged ischemia time
- Severe contamination
- Psychological instability

Fingertip amputation

• Commonly employed flaps
  – finger tip
    • V-Y advancement, cross finger flap, island flap (retrograde or antegrade flow), thenar flap (index or long finger only), bioengineered products (Matristem extracellular matrix).
  – thumb
    • <2cm: Moberg Advancement Flap
    • >2cm: Neurovascular island Flap (Littler) or FDMA
    • Full pulp loss: toe transfer/wrap around flap

V-Y advancement flap

Panattoni, 2013
Cross finger flap
Cross finger flap
Island Flap

Index finger: antegrade flow, Ring finger: retrograde flow

Panattoni, 2013
Toe transfer

Panattoni, 2013
Finger/Ray amputation

- If reconstruction/replant with flap is not indicated (severe crush injuries with bone loss, contamination, patient clinically unstable), amputation should be done following the principles to optimize the functional outcome.
Primary finger amputation

Severe crush injury with contamination

Bone deglovement (arrows)
Primary finger amputation

3 w s/p surgery

Panattoni, 2015
Primary amputation indication

- Severely crushed or mangled parts
- No bone support for reconstruction
- Anticipated functional outcome of amputation is superior than successful replantation or reconstruction
- Other serious injuries or diseases
- Prolonged ischemia time
- Severe contamination
- Psychological instability
Principles of finger amputation

- Debridement of all non-viable tissue
- Preserve functional length
- Smooth bone edges
- Careful handling of nerves with sharp transection allowing to retract proximally (prevent neuroma formation)
Principles of finger amputation

– DO NOT suture flexor to extensor tendons to prevent Quadrigia effect
– Prevent ingrowth nail (nail fold excision)
– Adequate skin padding (remove dog ears)
– Optimize the functional outcome (grip function)
Spare Parts Technique

– Principles:

• Some portion of the amputated or mangled tissue is available for reconstruction

• Digits rendered so badly damaged that function will never return should be considered for spare parts to other salvageable digits

• Highly contaminated tissue should not be used as spare parts as this could put the patient at risk

• Never discard any tissue until the procedure is over

Case example: Spare parts technique

- 41 yo male, r hand GSW with highly comminuted fracture on thumb and long finger IPJ

- RLF underwent primary amputation and spare parts used to save the thumb

Panattoni, 2016
Case example 1:
Spare parts technique

- RLF amputated P3 used as a graft to fix highly comminuted thumb P1 fracture with bone loss

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Case example:
Spare parts technique

- 6w s/p: functional outcome with adequate stump on amputated finger and preservation of thumb

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Ray amputation

• Excellent functional outcomes, specially on second and fifth rays

• Early recovery

• Allow the use of spare parts
  – Skin (fillet flap)
  – Nerve (graft/transfer)
  – Bone/tendon (graft/transfer)
Case example: 5th ray amputation

- 22 yo, GSW, severe bone loss at MPJ, skin defect

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• IV MTC ORIF, V ray amputation and filet flap
Wrist/forearm/arm level amputations
Anatomic Considerations

• Maximize the length of the amputation stump
  – Free tissue transfer to retain length
  – Forearm: preserve prono-supination
  – Preservation of elbow and shoulder

• Neuroma prevention (cut nerves under gentle traction)

• Tenodesis (to maintain resting muscle tension)

Forearm Amputation

• Most common UE amputation proximal to wrist

• Maintain minimum of 5cm of ulna for prosthesis fitting/preserve elbow flexion

• Biceps tendon transfer to ulna

• Preservation of length for maximal prono-supination

• 6-8cm of distal radius/ulna resection to provide muscle coverage

Elbow Disarticulation

- Least common of the UE amputations
- Preserved ability for IR/ER transmission to prosthesis
- Allows for weight bearing surface when no prosthesis is used
- Preferred to trans-humeral amputation

Rehabilitation Goals

- Residual Limb Shrinkage and Shaping
- Limb Desensitization
- Maintain joint range of motion
- Strengthen residual limb
- Maximize self reliance
- Early prosthetic fitting
- Patient education: Future goals and prosthetic options

Amputation Outcomes

• Phantom limb pain is common

• Functionality and prosthetic use decreases with more proximal amputations

• Reichle et al showed higher rate of prosthesis rejection in UE vs LE amputations 44% vs 16% respectively
  – Below-elbow amputations predicting better prosthesis use

Amputation Outcomes

• Reasons for revision amputations
  – HO
  – Infection
  – Neuromas
  – Contractures

* Tintle et al. showed the use of prosthesis increased from 19% to 87% after revision surgery suggesting lack of use of prosthesis may be due to reversible factors

References


References


• For questions or comments, please contact the OTA Business Office at OTA@ota.org