Comprehensive Orthopaedic Review
Upper Extremity Amputations
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2 Flap Definitions
- Island - flap of skin and subcutaneous tissue supported by a pedicle of nutrient vessels
- Rotational – a local pedicle flap mobilized by counterincision at base of flap
- Axial – a myocutaneous flap containing an artery in its long axis
- Transposition – rectangular flap of skin repositioned to fill a defect.
- Advancement – flap carried to its new position by sliding technique

3 Volar V-Y Advancement Flap
- Described in 1970 by Atasoy-Kleinert
- Preserves digital length
- Apex of V flap is at DIPJ flexion crease
- Base of V flap is distal, same width as pulp defect
- Must mobilize flap carefully at level of FDP
- Advance flap distally and inset to nailbed converting V-to-Y

4 Reconstruction of the amputated fingertip with a triangular volar flap
Atasoy et al., JBJS 1970; 52A: 921–26
- Case series – 61 patients, 64 fingers
- Indicated for transverse or dorsal oblique pulp defects
- Patient age range – 14 mo – 85 yrs
- Metacarpal block anesthesia
- Simple procedure to preserve near normal sensation

5 Treatment Goals for Digital Amputations
- Preserve functional length (FDP, FDS intact?)
- Durable stump coverage with useful sensitivity
- Avoidance of symptomatic neuromas
- Avoidance of joint contractures
- Minimizing length of convalescence

6 Flap Selection
- Moberg Advancement – thumb pulp defects < 1 cm (up to 2 cm in some cases)
- Thenar – volar oblique defects, index or middle fingers, younger patients
- Volar Atasoy V-Y or lateral Kutler V-Y – for smaller defects < 1 cm
- Cross-finger flap – volar oblique defects
- STSG – coverage on dorsum of finger, but not durable enough for volar coverage
- Axial flag flap (based on first dorsal metacarpal artery) – dorsal thumb coverage

7 Amputation Outcomes
- Morbidity is constant regardless of reconstruction method
- Morbidity from amputation with pulp loss is function of injury itself, not rx method
- Cold intolerance – 30%-50%
- Sensory deficit – 30%

8 Thenar Flap
- Preserves length of finger
- Indicated for index or middle fingers only, best for younger patients
- Gatewood 1926 and Flatt 1957 used one proximal flap – skin grafted donor defect
- Smith and Albin 1976 popularized the “H flap” raising both proximal and distal flaps
• Proximal flap still used to cover pulp defect
• Distal flap used to cover donor defect at thenar eminence

9 [The Thenar Flap: Analysis of 150 Cases](#)
-Melone et al., JHS 1982; 7A: 291–97
-Case series – 120 men, 30 women; 31 pts > 50 yrs
-Advantages – good color match, abundant subcutaneous tissue available for coverage, inconspicuous donor site
-Technique keys – donor site near thumb MCPJ, flex recipient MCPJ, divide pedicle at 2 weeks, start early digital motion
• PIPJ contractures in 6 patients (4%)
• Excellent tip coverage for large pulp loss, all age groups (in this study)

10 [Moberg Technique](#)
-Radial and ulnar midaxial incisions
-Flap based on both digital arteries
-Dissection at level FPL sheath
-Limit flap advancement < 1 cm
-IPJ flexion contracture most common complaint
-Cold intolerance in 10–30%

11 [Functional outcome after the Moberg advancement flap in the thumb](#)
-Baumeister et al., JHS 2002; 27A: 105–14
-Case series – 36 patients with loss thumb pulp
-Independent blood supply dorsum of thumb
-All defects < 2 cm were successfully covered
• Excellent IPJ flexion, distal sensation excellent in 74%
• 22% cases required revision, 5 needed shortening (2 cm may be too much)
• Most common compliant – cold intolerance

12 [Ray Amputation](#)
-Generally not in trauma setting except for ring avulsions with skin loss to P1 level
-Usually reserved as a secondary procedure for post-traumatic impairment
-May be used as primary procedure for infection, tumor
-Improves hand cosmesis and function, but compromises grip strength

13 [Transmetacarpal amputation of the index finger:](#)
-Hand strength and complications
-Murray et al., JHS 1977; 2A: 471–81
-Case series – 41 patients with index ray amputations studied
-Average 20% reduction in power grip, key pinch and supination strength
-In other studies, loss of grip strength ranged from 14% to 29–34%
-59% incidence of hyperesthesia (improved by burying digital nerves into interossei)

14 [Ring Finger Ray Amputation](#)
-Complete ring finger metacarpal excision possible since there are no tendinous attachments at its base and the hamatometacarpal joint is very mobile
-Ligaments between small finger metacarpal and hamate may be incised
-Postoperatively the small finger metacarpal will drift radially
-Gap between middle and small finger also narrowed by repairing the volar intermetacarpal ligaments distally

15 [Amputation Complications](#)
-Neuroma, dysesthesia
Lumbrical-plus finger
Pinch bypass (index)
Grasping gap (central)

**16 Lumbrical-Plus Finger**
- FDP released and allowed to retract proximally
- Proximal retraction of FDP and lumbrical may increase tension on radial intrinsic
- Active flexion of the digit further increases tension sometimes forcing the PIPJ into paradoxical extension
- Lumbrical tenotomy permits full retraction of FDP and allows FDS to control PIPJ flexion

**17 The Spiral Flap for Fingertip Resurfacing:**
Short-Term and Long-Term Results
Lim et al., JHS 2008; 33A: 340–47
- 32 patients with average 1.5 x 2.0 cm pulp defects
- Long-term follow-up was 13 years
- Results showed full digital ROM, normal static two-point discrimination = 4 mm
- No hypersensitivity or cold intolerance
- Level IV Therapeutic study (Singapore)

**18 Factors Influencing Use of Digital Prostheses in Workers’ Compensation Recipients**
Hopper et al., JHS 2000; 25A: 80–85
- 178 patients completed questionnaire at 6 months post-injury
- 110 (62%) reported stump problems
- 37 (21%) indicated that stump pain interfered with prosthetic use
- Low utilization – single ring finger, stump problems, distal amputation, male gender
- No good predictor of prosthetic utilization was found

**19 Prosthetic Usage in Major Upper Extremity Amputations**
Wright et al., JHS 1995; 20A: 619–22
- 135 patients with prostheses after major upper extremity amputations were studied by questionnaire with a mean follow-up of 12 years
- Usage rates for prostheses: shoulder disarticulation 40%, above elbow 43%, wrist disarticulation 54%, below elbow 94%
- Patients with wrist disarticulation preferred long sensate stump to insensate prosthesis
- Below elbow amputees have highest usage rate and should have prosthesis prescribed
- Above elbow amputees, amputees with stiff shoulder and/or brachial plexus injury usually reject prosthesis

**20 Myoelectric Prosthesis Definitions**
- Myoplasty – connecting antagonist muscles together to maintain active muscle function
- Myodesis – attaching muscle to bone
- Tunnel cineplasty – attaching muscle to the prosthesis
- Neurotization – surgical reinnervation of denervated muscle using donor nerve
- Myotomy – cutting a muscle and allowing it to retract proximally

**21 Krukenberg Procedure**
- Described by Krukenberg, a German army surgeon, in 1917
- Classic indication is for bilateral hand amputee who is blind
- Forearm procedure converts radius and ulna into claw–like pincer
- Requires 8–12 cm stump, pronator teres, mobile ulnohumeral joint
- Radius is mobile ray (BR, FCR, ECRL, ECRB)
• Ulna is fixed ray (FCU, ECU, EDQ)
• Wrist extension opens the pincer, wrist flexion closes the pincer

22 Cold Intolerance
• Most common sequela of digital amputation
• More common in colder climates
• Does not improve over time
• Believed to result from initial trauma mediated by the sympathetic nervous system
• Not correlated with type of treatment, vessel patency or blood flow

23 Review Articles for Read File
• Current Concepts
  Management of Fingertip Injuries
  Peterson et al., JHS 2014; 39A: 2093–2101
• Surgical Technique
  Reconstruction of Fingertip Injuries: Surgical Tips and Avoiding Complications
  Panattoni et al., JHS 2015; 40A: 1016–24

24 www.drhearon.com
  education > residents’ file
  outline including key references