excellence in education
for OTs and PTs
since 1990

THE THUMB

LEARNING OBJECTIVES
1 describe the detailed anatomy of the thumb
2 interpret x-ray images at a basic level
3 collect a good history and exam for most thumb conditions
4 educate patients regarding common conditions and treatments

DOCTORS DEMYSTIFY THE THUMB

METHODS
• 14 lectures
• 2 question and answer sessions
• networking

• some repetition between talks
  – bad news: unavoidable because of multiple speakers
  – good news: repetition is a good learning tool

Course Content Meets These
AOTA Classification Codes for CE activities
Category 1: Domain of OT
  Areas of occupation: ADLs
  Performance skills: motor skills
  Activity demands: required actions, body functions and structures
Category 2: OT Process
  Develop intervention plan/approaches
  Implement intervention
Category 3: Professional Issues
  OT education: teaching theory and methods
  Supervision: competence
  Contemporary issues/trends: professional development/continuing competence

The Thumb for OTs and PTs

For Your Questions during the Discussion Sessions:
Write them on notecards as you think of them

Practical Matters
Can everybody see? Hear?
Room temperature?
Cell phones, beepers
Auditorium’s policy on food/beverage
Restrooms
Evaluation forms and certificates
Ready, set, go……

01 Cross-Sectional- Anotomy
01 Cross-Sectional Anatomy

- Right upper limb
- As if standing on fingertip and looking toward shoulder
- Understanding cross-sections helps you to visualize 3-D anatomy

![Diagrams of cross-sectional anatomy showing various structures](image)

- **Yellow arrows point to structures to be identified**

- **Thumb nail**

- **Thumb distal phalanx—at the same level as 2nd, 3rd and 4th webs when thumb is adducted**

- **index-middle web**

- **Volar plate**

- **Proximal phalangeal bases**

- **Yellow arrows point to structures to be identified**

- **Thumb nail**

- **Thumb distal phalanx—at the same level as 2nd, 3rd and 4th webs when thumb is adducted**

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- **Proximal phalangeal bases**

1. Distal phalanx
2. Proximal phalanx
3. Terminal tendon
4. Flexor pollicis longus
1. First dorsal interosseous muscle
2. Flexor pollicis longus
3. Annular pulley

Distal portion of mc shafts

1. Base of proximal phalanx
2. Flexor pollicis longus
3. Annular pulley
4. Adductor pollicis

Mid portion of metacarpal shafts

1. First dorsal interosseous
2. Collateral ligament
3. Insertion of thenar muscles

Proximal portion of metacarpal shafts

Thenar muscles meld together and cannot be specifically identified except for deep head of FPB

1. 1st dorsal interosseous
2. Adductor pollicis
3. Branching of median nerve
The last one!
Site of Intersection Syndrome
1  ECRL
2  ECRB
3  APL
4  EPB

02 Imaging

Sesamoid Bones
• Accessory bones confused for fractures
• Last to ossify: 11-15 yrs
• MP Joint: 2 sesamoids
  – Adductor sesamoid
  – FPB sesamoid
  – Attachment point for muscles
  – Incorporated into palmar plate
• IP Joint: Single sesamoid variably present

Imaging of the Thumb
Here’s the first thing patients see on their thumb x-ray.
“What is that?”

Imaging the Thumb
• Standard Hand X-rays
  – 3 views of the hand
    • PA
    • Oblique
    • Lateral
  – Do not account for anatomic position of the thumb: Rotated 90 degrees from second metacarpal
  – Separate anatomic plane

Posterior-anterior of hand is oblique of thumb
Imaging the Thumb

- The thumb requires dedicated views
- True lateral view
  – Over-pronation with radial border flat on cassette
- True AP view
  – Over-pronation with dorsal border flat on cassette
  – Robert’s view
**Imaging the Thumb**

- **Bony Anatomy**
  - Trapezium
  - Metacarpal
  - 2 phalanges vs. 3 in other digits
    - Proximal
    - Distal
- **Joints**
  - Metacarpotrapezial
  - Metacarpophalangeal
  - Interphalangeal

**Trapezium**

- Greater multangular
- 6 distinct surfaces
- Articulations
  - Proximal: scaphoid
  - Distal: metacarpal
  - Ulnar: trapezoid, index metacarpal
- Volar surface
  - FCR tendon

**Trapezium**

- Ossification
  - 3-8 years
  - Rounded
    - Similar to Metacarpal head
    - Phylogenetically
      - Short Metacarpal

**Metacarpal**

- Thicker and broader
- Smooth dorsal surface
- Articulations
  - Trapezium
  - Proximal phalanx
  - No ulnar/radial
- Base
  - Volar Beak

**Metacarpal**

- Ossification
  - Primary: 9 weeks
  - Secondary: 1 – 3.5 yrs.
- Epiphyseal growth plate
  - Proximal
- Phylogenetically
  - Proximal Phalanx

**Proximal Phalanx**

- Base
  - Concave articulating facet for metacarpal
  - Radial/Ulnar eminence for collateral ligaments
- Shaft
  - Concave volarily
  - Convex distally
- Head
  - Two condyles
  - Convex articulating surface
Distal Phalanx
- Base:
  - Biconcave articulation with proximal phalanx
- Head
  - Non-articular
  - Tapered transversely
  - Tuft beneath nail bed
- Shaft
  - Convex dorsally
  - Straight volarly
  - Roughened surface

Phalanges
- Ossification:
  - Primary: 8th – 12th wk.
  - Secondary: 5 months – 3 yrs.
  - Epiphyseal plate proximal

Trapeziometacarpal Joint
- Biconcave double-saddle joint
- Permissively loose capsule
- Full circumduction
- Most degrees of freedom
- Beak of metacarpal
  - Insertion of anterior oblique ligament: CMC arthritis

Metacarpophalangeal Joint
- Stouter joint than other digits
- Less ROM than other MP joints
- Radial articular surface larger
- Highest variability of motion among patients
- Round MC head = 80° flxn
  Flat MC head = 20° flxn

Interphalangeal Joint
- Pure flexion/extension
- Proximal phalanx
- Ulnar head shorter/flatter than radial
- 5-10 degrees of tip pronation with flexion
- Stable pulp-to-pulp pinch

Other Imaging Modalities
- Clinical exam and plain radiographs are often adequate for diagnosis
- CT/MRI rarely required for diagnosis of thumb pathology
EXAMINATION OF THE THUMB

Let’s start with a quiz…

Quiz!
What’s most important to arrive at a diagnosis?
Images?
Exam?
History?
Answer: History! The patient has been doing an on-the-job exam since the symptoms started. Listening to the patient and asking the right questions will often lead to the diagnosis. Then the exam and images can be merely confirmatory.

History
(the patient giving you the results of their exam)
• How did it start? When did it start?
• What do you notice? When do you notice it?
• What makes it worse? What makes it better?
• Ever had it before? Other hand affected?
• What does it keep you from doing?
• Is it a disability or just an annoyance?
• Ask patient “What do you think is going on?

Physical Examination
Inspection and Palpation
Knowledge of Anatomy is Key
Examine:
• Bone alignment
• Muscle Function
• Tendon Function
• Joint Motion
• Joint Stability
• Nerve Function
• Vascular Function
• Skin Integrity

Looking for:
• Color/temp. change, bruising
• Induration, fluctuance, atrophy
• Deformity, stiffness, instability
• Masses, calluses, pulsations
• Snaps, crackles, pops, clunks
• Hair growth, sweat pattern
• Sensibility, tenderness
• Hypertrophy, atrophy
• Nail changes

Dirty
Scissoring
Little

Even experienced surgeons and therapists probably never do a “complete” exam
• Two exams have probably never been done in same order, so..
• Based on the history, start where the money is. —eg, joint problem? Exam the joints first.
And…
• Test everybody for trigger digits and CTS
• You only find what you look for!
Some pearls are in order

- Accurately describe thumb motions
- Compare findings to opposite side
- Quantitate findings whenever possible
- Knowledge of anatomy is paramount

Definition of Thumb Motions

Abduction
Palmar Planar
(Away from palm) (In plane of palm)

Thumb Motions

Extension
Adduction

“Normal” MCP Motion

- Extension to 0 degrees is normal; hyperextension to 10 degrees is not unusual.
- Flexion varies from 20 to 90 degrees depending on the individual.

“Normal” IP Motion

- Flexion to 80-90 degrees is possible
- Hyperextension to 10 degrees is common

Normal findings?
Not when compared to the other side!
PINCH STRENGTH

Manual muscle testing grades:
0 no activity, 1 flicker, 2 gravity neutralized, 3 against gravity, 4 against moderate resistance, 5 normal

Muscle Atrophy
• Generalized: suggest central nervous system, neck or shoulder problem
• Specific muscles: suggest isolated nerve

Nerve Assessment: Motor Function
• Radial nerve: test EPL (table top test) (the intrinsics can extend IP when MP is flexed)
• Median: FPL, palmar abduction
  – Anterior interosseous nerve: OK sign
• Ulnar: pinch

Nerve Assessment: Sensibility
• Radial: test dorsal thumb-index web space
• Median: test palmar surface of index or thumb
  – Caution: only narrow central strip of thumb pulp is pure median nerve, rest is radial nerve
• Ulnar: test palmar aspect of little finger

Vascular Assessment
Capillary refill (normal < 2 seconds) Allen Test Digital Allen Test

Quantitate! Two-point discrimination vs. monofilament testing (innervation density vs. threshold testing) Know when it is appropriate to use each
MP Joint Stability
Test at full extension and at 30° flexion
20-30° medial/lateral laxity is normal
Grading Ligament Injuries
Grade 1: no laxity, pain+
Grade 2: some laxity with firm end point, pain+
Grade 3: marked laxity without end point, pain+/-

MP Anterior-Posterior Joint Stability
Good Indicator of Overall Ligament Laxity

CMC Joint Stability and Health
CMC Grind
CMC Translation

Final Quiz!
Match Signs with Names
A  Finkelstein sign
B  Froment sign
C  Jeanne sign

Exam: Bottom Line
- Listen to the patient.
  - They will recount their extensive exam.
- Know the anatomy.
- Quantitate your exam.
- Practice makes perfect.

04 Fracture
Introduction

- Review the common patterns of fracture in the thumb
- Therapeutic Implications

Topics of Discussion

- Anatomy
- Biomechanics
- Fracture Types
- Treatment

Anatomical considerations

- Ligament attachments
- Tendon insertions
- Joint geometry

Biomechanics

- Ligament holds
  - Static deformity
- Tendon pulls
  - Dynamic deformity
- Joint geometry determines direction
  - Patterns of deformity

Specific Fractures

- Around the Basal joint
- Metacarpal shaft
- Around MP joint
- Proximal phalanx
- Distal phalanx
Forces in the thumb

Anatomy of Saddle Joint

“Pringle Joint”

Anatomy of the Basal Joint

Edward Bennett, Professor of Surgery
Died: Dublin, Ireland 1907
Fracture Subluxation CMC joint

Bennett’s Fracture

Small ulnar fragment
Held by Volar ligament
Rest of the metacarpal
Subluxated dorsally
by the APL pull
Rolando’s Fracture
- 1910
- Deceptively benign Radiograph
- Comminuted intra-articular
- Base of thumb metacarpal
- Worse prognosis

Metacarpal Shaft Fracture
- Deforming Forces
- APL
- Abd.Pol.B
- Flex.Pol.B
- Add.Pollicis

Proximal Phalanx
- Extra-articular
- Intra-articular

Distal Phalanx Fx
- Nail bed fracture
- Flexor tendon avulsion
- Extensor tendon avulsion
- Fx/Dx
Distal Phalanx fx

- Homologous to Mid. Phalanx
- Fx/Dx
- Pilon fx

Treatment of Thumb Fractures

- Closed
- Open
- Internal Fixation
- External fixation

Treatment of Bennett’s Fx.

- Closed reduction
- Internal fixation of the joint subluxation

Treatment of Bennett’s Fx

- Open Reduction
- Internal fixation

Treatment of Rolando’s Fx

- Open Reduction
- Internal fixation
**Treatment of shaft fracture**

- Closed reduction
  - Cast
  - K-wire
- Open Reduction
  - Internal fixation

**Treatment of shaft fx.**

- Internal Fixation
  - [Image]
- External fixation
  - [Image]

**Treatment of Proximal Phalanx**

- Non-articular
  - Cast
  - Closed reduction
  - K-wire
- Intra-articular
  - ORIF

**Treatment of Proximal phalanx fx.**

- [Image]

**Treatment Distal Phalanx Fx/Dx**

- Like PIP joint
- Closed reduction
- Volar plate
- Arthroplasty

**Distal phalanx Pilon fx**

- [Image]
After 6 months

Rehabilitation

- Short term:
  - Stability vs. motion

- Long term:
  - Contracture
  - Strength

Rehabilitation
General concepts in thumb

- Stability more important than motion
- Motion adapted to fx. Stability
- IP joint motion
- Start Active motion first
- Delay power pinch >6 wks

Rehabilitation
General concept in the thumb

- Finger ROM
- Elbow & shoulder motion
- Check Ulnar dig. Nerve in splint
- DISTAL (IP) joint ROM
- Tendon glide

Rehabilitation

- Closed reduction & cast or K-wire
  - Immobilized 4-6 wks of cast
  - Then thumb splinting period
  - Wean off over 3 weeks

Rehabilitation

- ORIF
  - Assess intra-op stability
    - Cast or splint 1-3 weeks
    - Protection splint
    - Active protected ROM
05 Dislocations

Introduction

- Anatomy
- Evaluation of injured joint
- IP joint
- MP joint
- CMC joint

Conclusion

- Unique Anatomy...
- Role of lig’s & tendons
- Cast, K-wire, ORIF, & Ex.fix.
- Stability most important
- Modified, adaptive rehab.

Thank You

Thumb Dislocations

Ali Ghiassi M.D.

MP & IP Joint Anatomy

- Collateral ligaments (red) and volar plate (blue) provide joint stability
- They form a 3-D ligament complex that is similar to a side of a box
- 2 sides of box must be disrupted for dislocation
- Assume rupture of 1 collateral ligament and volar plate with dorsal dislocations
- Assume rupture of collateral ligament and extensor tendon with volar dislocations
CMC Joint Anatomy

- Unlike the IP and MP joints CMC joint is biconcave saddle joint
- Has little intrinsic stability

Clinical Evaluation

- Try to assess the mechanism and direction of forces of injury
- Open vs. Closed (Look for open wounds)
- Simple vs. Complex (Closed vs Open reduction)
- Stable vs. Unstable (Assessed after reduction)
- Associated with fractures (X-rays)

Clinical Evaluation of Joint Injury

- Various degrees of instability
- Depends on the ligament and bony disruption during injury
  - SPRAIN Stable
  - DISLOCATION More unstable
  - FRACTURE/DISLOCATION Grossly unstable

Ligament Stability

- Several grades of stability of ligaments
- Grade I: Macroscopic continuity;
  Microscopic tears of some fibers
- Grade II: Macroscopic continuity; Laxity of ligament to stress
- Grade III: Macroscopic discontinuity; Complete disruption

Clinical Evaluation of Ligaments

- Grade I localized pain and swelling
- Grade II is inferred when there is significant swelling and pain with stressing off ligament
- Grade III assume a dislocation
**Thumb IP Joint**

- Dislocations are infrequent
- Usually dorsal, or lateral
- Caused by hyperextension injury
- Often associated with open volar wounds

**Thumb IP Joint**

- Joint is immobilized in 20 deg. Flexion
- Dorsal splint for 2-3 weeks
- Active flexion is encouraged after first week
- Avoid extension past 20 degrees in first 3 weeks
- Avoid hyperextension

**Thumb IP Joint**

- Rarely irreducible (complex)
- Usually volar plate is blocking reduction
- Rarely flexor tendon, sesamoid, fracture fragment are blocks to reduction
- Requires open reduction
- Post-op rehab is similar to simple dislocations

**Thumb IP Joint**

- Need to ensure proper reduction
- This joint is subluxed
- Open reduction is needed to remove tissue blocking reduction
- Temporary K-wire fixation may be needed to maintain reduction

**Thumb IP Joint**

- Pure volar dislocations are rare
- Treatment is similar to mallet fingers
- Splint in full extension for 6 to 8 weeks with progressive mobilization

**MP Dislocations**

- Most are dorsal
- Hyperextension injury with rupture of volar plate, capsule and one collateral ligament
- Volar plate rupture is from MC head
- Most are reducible
MP Dislocations

- Irreducible (complex) dislocations are caused by (FPL), volar plate, sesamoid
- Open reduction is required to remove interposed tissue
- Dorsal, volar or combined approach may be required
- Once reduced K-wire fixation if unstable

Instability

- Rarely is CL instability > 30 degrees
- Usually stable
- Collateral ligament stability is assessed
- Immobilized 25 degree of flexion 4 weeks

Locked MP Joint

- Rare entity
- Joint is subluxed and not frankly dislocated
- Joint can not be flexed or extended
- Entrapment of palmar plate in joint
- Most require open reduction and removal of tissue from joint

Chronic MP Dislocations

- There is joint destruction
- Gross deformity and pain and lack of function
- MP fusion in 20-30 flexion to restore function and reduce pain

CMC Dislocations

- Pure dislocation are very rare
- Dislocations with fractures are common
- Hand full of cases described in literature
- Stable with 4 weeks of immobilization
- If unstable K-wire fixation is required
- All tend to be dorsal

CMC Dislocations

- Post-traumatic CMC pain without instability may have partial volar ligament tear
- Immobilized 4 weeks abduction-extension
Rarely patients may have chronic instability without dislocation or arthritis

- Volar ligament rupture due to chronic injury (repetitive axial loads)
- Require volar ligament reconstruction
- Half of FCR used to reconstruct volar ligaments
- Usually immobilized 4-6 weeks

**Goals**

- Anatomy
- UCL injuries (Gamekeeper’s Thumb)
- Ulnar avulsion fractures
- RCL injuries

**Anatomy:** Thumb MP joint

- Condyloid
  - Ovoid condyle
  - Elliptical cavity
- Motions
  - Flexion/Extension
  - Adduction/Abduction
  - Rotation (lesser)

**Anatomy:** Ligaments

- Collateral ligament
- Accessory collateral ligament
- Volar plate
- Varus/Valgus
- Dorsal/Volar support

Collateral Ligament Injuries of the Thumb MP Joint

Michiyuki Kono, M.D.
**Anatomy: Intrinsics**

- Adductor (ulnar sesamoid)
- Abductor & FPB (radial sesamoid)
- Secondary insertion: aponeurosis into extensor tendon

**Ulnar Collateral Ligament Injuries**

**Acute: Skier’s Thumb**

- Fall onto outstretched hand
- Thumb abducted and extended

**Acute Ligament Injury**

- **Grade 1:**
  - Partial injury
  - No instability
- **Grade 2:**
  - Complete ligament injury
  - Laxity up to 30°
  - Secondary restraints intact

**Grade 3:**

- Complete ligament injury
- Secondary restraints also injured
- Laxity > 30°

**UCL almost always tears either midsubstance or at distal insertion on proximal phalanx**
**Stener Lesion**

- Grade 3 “plus”
- Avulsed distal end of UCL displaced by adductor aponeurosis

**Evaluation**

- History
- Exam
- X-rays

**Exam**

- Stress test at 0° and 30°
- Test for endpoint
- Side-to-side difference
- May need to block with local anesthetic

**X-rays**

- Rule out fracture
- Assess for dorso-volar instability

**Treatment**

- Grade 1 & 2
  - Immobilization 4 weeks
  - Protected motion until nontender
Treatment

• Grade 3
  • Stener lesion prevents ligament ends from healing to each other

• Secondary capsular injury

Surgical Repair

Surgical repair - anchor

Post op Care

• Surgeon variability depending on strength of repair

• Immobilization 2-4 weeks

• Protected motion 2-4 weeks

• ROM and progressive strengthening at 6 weeks
Chronic: Gamekeeper’s Thumb

• Chronic UCL instability in Scottish gamekeepers
• Killed wounded rabbits by breaking necks

Evaluation

• Identical to acute injury
• History notable for injury in past, or chronic repetitive stress

Chronic

• Pain
• Instability
• Weakness of grip and pinch

Surgery

• Reconstruction with palmaris longus graft
• Rehab same as for acute repair

Late

• Eventual development of OA
• Fusion

Avulsion Fractures

Proximal Phalanx Avulsion

• May be equivalent to Grade 3 ligament injury
• Surgical fixation if unstable
Surgical options

• Suture repair
  • Button
  • Bone bridge
• Bone anchors

K-wires or screws
• if fragment large enough
• Rehab: same as for acute ligament repair

Radial Collateral Ligament Injuries

• Rare compared to UCL injuries
• 10:1

Abductor aponeurosis is wide
• Ligament tends to avulse off metacarpal
• No “Stener” lesion

Treatment

• Controversial
• Immobilization 4-6 weeks vs.
• Surgical repair

Surgery

• Same options as for UCL
  • Direct repair
  • Bone anchor/suture
  • Reconstruction
THUMB TENDINITIS

TRIGGER THUMB

• Thumb, middle and ring fingers most common
• Flexion & extension → painful snapping
• Thumb can become locked in flxn or extn
  • *Primary Trigger Thumb* - idiopathic
  • *Secondary Trigger Thumb* - assc. with systemic diseases (diabetes, rheumatoid arthritis, hypothyroidism)

TRIGGER THUMB ASSOC. WITH OTHER ENTRAPMENT SYNDROMES:

- DeQuervains, CTS
- Some people are just put together more tightly than others

PATHOLOGY

- disproportion in size between flexor tendon & A1 pulley at metacarpal head
- fibrocartilaginous metaplasia of A1 pulley (type III collagen & chondrocytes)
- reactive intratendinous nodule - flexor tendon

ANNULAR PULLEY
TRIGGER THUMB

- Pain/triggering: either at proximal flexion crease or over dorsum of thumb
  - Patient may swear that symptoms are coming from IP joint—arthritis!
- Tenderness over A1 pulley (MCP flexion crease) with palpable nodule ± triggering

Differential Diagnosis
- Remote tenosynovitis (de Quervain’s, EPL)
- Arthritis
  - CMC
  - MCP
- Metabolic Disease (gout, pseudogout)
- Infection (TB, fungal)
- Tumor

Injection (preferred by surgeons!)
- 1 cures ~50%, 2 cure ~90%
- Patients with 2° trigger digits respond poorly to injection
- Low complication when injections spaced >1 month apart; maximum 2 injections per year
- Splinting in extension (preferred by therapists!)
  - Less effective than injection?
  - More encumbering

Hyperglycemic effect can last for at least 5 days
- May be efficacious half the time
- Corticosteroid injections did not decrease the surgery rate
- Less effective in patients with systemic manifestations DM
TRIGGER THUMB: Surgical Treatment

- Open release of the A1 pulley
  - Digital nerves are nearby in thumb
  - Oblique pulley must be maintained
  - Complications: digital nerve injury, RSD, infection, stiffness, tenderness
- Percutaneous Trigger Digit Release
  - High success rate, low complication rate
  - Concern for use in thumb due to radial digital nerve crossing over

TRIGGER THUMB: Congenital

- Often noted by grandmother
- IP joint fixed in flexion
- No triggering
- Notta’s node noted on exam
- Not actually present at birth
- No surgeon willing to do injection
- Some resolve over time, extension splint helps
- Surgical release, esp > 3 years old

DE QUERVAIN DISEASE

- Stenosing tendinitis
  - 1st Dorsal Compartment (EPB & APL)
- Attributed to repetitive thumb abduction & ulnar deviation of the wrist
  - Most common in new mothers
    - Nursing with wrist in awkward position
    - Unaccustomed lifting with ulnar to radial deviation
- Radial-sided wrist pain, aggravated by thumb movement & ulnar deviation of the wrist

DE QUERVAIN DISEASE

Can often diagnosis from history and inspection alone.
DE QUERVAIN DISEASE:

Exam
- Local tenderness
- Bone-hard thickness over 1st comp. (1-2 cm proximal to radial styloid)
- + Finkelstein's test

Differential Diagnosis
- CMC osteoarthritis (different age group, + grind test, + x-ray)
- Intersection syndrome (to be discussed momentarily) (tender and thick more proximally)
- Wartenberg’s radial neuritis (+ Tinel’s)
- Various radial-sided carpal conditions

DE QUERVAIN DISEASE:

Treatment
- Injection:
  - OK when breast feeding
  - 1 injection cures ~50%, 2 cures ~90%
  - Complications: fat atrophy, depigmentation
- Splinting
  - relieves symptoms
  - renders thumb useless

Surgical release of the entire 1st dorsal compartment
- Complications
  - Superficial radial nerve
  - Incomplete relief of entrapment
  - Subluxing APL and EPB by too extensive release
  - Wound/Scar

INTERSECTION SYNDROME

Associated with repetitive wrist activity
- Kayaking, volleyball

Pain and swelling where APL and EPB cross over ECRB and ECRL
INTERSECTION SYNDROME
• Findings
  – Tender along APL/EPB muscle bellies
  – Crepitation felt/heard with thumb movements
• Treatment
  – Rest
  – Splint in wrist extension
  – Cortisone injection
  – Release fascia over APL/EPB

EPL TENOSYNOVITIS
• Stenosing tendinitis of the 3rd comp.
• Pain, swelling & tenderness at Lister’s tubercle over dorsum of distal radius
• Associated with RA & distal radius fractures

EPL TENOSYNOVITIS
• Operative treatment is recommended to prevent attritional rupture of the EPL tendon
  – Release of 3rd compartment & subcutaneous transposition of EPL tendon

FCR TENOSYNOVITIS
• Not really affecting thumb but can mimic CMC and STT osteoarthritis
• Poorly recognized tenosynovitis of the FCR (fibroosseous canal - scaphoid & trapezium)

FCR TENOSYNOVITIS
• Pain at the palmar wrist crease over the scaphoid tubercle, ↑ pain with resisted wrist flexion & radial deviation
• Associated with trapezial degeneration
• Activity modification, splinting & steroid inj.
• Release of the fibroosseous canal recommended if conservative measures fail

THUMB TENDINITIS: Reading
3. Trigger thumb: www.emedicine.com/orthoped/topic571.htm
4. deQuervain’s: www.emedicine.com/orthoped/topic482.htm
5. Intersection syndrome: www.emedicine.com/orthoped/topic407.htm
Introduction

- The thumb is 40% of hand function
- Thumb amputations ideally treated by replantation versus alternative tissue reconstruction

Thumb Replantation

Definition of Terms

- Replantation - reattachment of a totally severed body part (i.e. thumb)
- Revascularization - re-establishing blood flow to a devascularized or partially amputated part

Definition of Terms

- Microsurgery - surgery requiring the use of an operating microscope
- Microvascular surgery - surgery on vessels <2.5mm in size
Replantation Timeline

- 1960 - Jules Jacobson described anastomosis between vessels 1.4 mm and coined the term “microsurgery”
- 1963 - Kleinert and Kasdan performed the first digit revascularization (thumb)
- 1968 - Komatsu and Tamai performed the first successful digit replantation (thumb)

Replantation Centers

- Experienced microsurgeons
- Efficient ground/air transportation
- Experienced OR staff and anesthetists
- Proper equipment
- Trained post-op nursing staff
- Trained therapists
- Psychosocial support

Evaluation

- Age
- Physical health
- Mental health
- Status of amputated part - degree of injury
- Time of injury
- Mechanism of injury

Mechanism of Injury

- Guillotine
- Crush
- Avulsion

All thumb amputations should be evaluated for replantation.

Preparation of the Amputated Part

- Wrap in dry gauze
- Place in watertight bag and place on ice
- Avoid freezing
- Successful replantation described beyond 48h of cold ischemia

Indications

- Always evaluate thumb amputation for possibility of replantation
- Motivation and intelligence
  - Length of surgery and hospital stay
  - Blood transfusion
  - Rehabilitation time
- Secondary surgery (tenolysis, amputation)
- Amputated part must have intact artery and vein
Contraindications

- Severe crush
- Multiple level amputation
- Psychiatric disorder
- Life-threatening concomitant injury
- Prolonged ischemia time
- Relative contraindications:
  - Co-existing vascular disease, cigarette smoking, diabetes, age

Definition of Success

- A warm, sensate, aesthetic and functional digit is the goal
- A viable yet insensate digit with poor function is not a success

Anatomy

- Putting the pieces together in sequence
- 1. Bone
- 2. Tendons
  - 1. Extensors (EPB, EPL)
  - 2. Flexor (FPL)
- 3. Artery (ulnar digital a.)
- 4. Nerve (digital nn. x 2)
- 5. Vein (1 or 2 dorsal vv.)
- 6. Skin

Bone

- Shortening
- Fixation
  - Interosseous wires, K-wires, external fixators, medullary bone screw, plate fixation
  - Fusion, especially IP joint

Tendons

FPL/EPL tendons
- Primary repair is best
- May require tendon reconstruction
- Primary grafting vs. late reconstruction

Artery

- Microvascular primary repair vs. vein grafts
- Ulnar digital artery is dominant vessel

Nerves

- Primary repair
- Nerve graft is best delayed for 2-3 months unless skin closure is impeccable

Veins

- Anastomose dorsal veins
- 2 veins for every artery
Skin Closure
- Avoid tight closure
- Skin graft as needed

Splint
- Bulky thumb spica splint
- No circumferential compression
- Window to monitor thumb

Postoperative Management
- IV Antibiotics
- Aspirin
- Selective anticoagulation
- Splinting & Elevation
- Monitoring
  - Avoid caffeine, coffee, chocolate, tea, smoking – vasoconstriction
  - Leech Therapy
  - Early Protective Motion (5 days post-op)

Case 1: Revascularization

Case 2: Replantation

Case 3: Salvage Replantation
Case 4: Reconstruction

Rehabilitation

- Flexor and extensor tendons involved
- Early Protective Motion Protocol
- EPM I
  - Dorsal protective splint - wrist neutral, thumb in mid abduction/extension, MP and IP at 15 degrees of flexion
  - Gentle passive CMC motion
  - Active wrist flexion to tension and extension to neutral

Rehabilitation

- EPM II
  - Begins POD 10-14
  - Gentle MP and IP flexion with CMC extended
  - Gentle MP and IP extension with CMC flexed
- Wrist extension beyond neutral at 4-5 weeks
- Composite motion and functional activities 5-6 weeks
- Splint discontinued at 6 weeks
- Strengthening at 6-8 weeks

Complications

- Thrombosis & Replant failure
- Cold Intolerance
- Hypo- or Hyperesthesia
- Tendon Adhesions
- Joint Stiffness
Outcomes

- 66-95% survival rate
- Type and extent of injury correlate w/ outcome
  - Good opposition, key pinch, circumduction
  - Temperature and light touch satisfactory
  - Transient cold intolerance
  - Most patients satisfied with results, returned to work

Outcomes

- Recovery of sensibility similar to simple nerve repair
- Mean static two-point discrimination 9 mm (clean), 12 mm (crush/avulsion)
- Improved outcomes with cleaner, distal, sharper injuries and younger patients
  - Better functional recovery in patients who underwent therapy
  - (finger replants)

Outcomes

- Buncke HJ (1991)
  - 60% overall re-operation rate (all digits)
    - Tenolysis and release of joint contractures (67%)
  - ORIF of nonunion (22%)
  - 11% re-operation rate for thumbs
- Mean cost $16,953 per part per patient
  - Cost of prosthesis is $3,000 and lasts 2-3 years- Lukash FN (1992)

References

- Buncke clinic, on-line textbook

References

- Articles

References

- Textbook
  - Goldner and Urbaniak in Green’s Operative Hand Surgery. 2005. Chapter 45
  - GM Buncke in Plastic Surgery 2nd ed. 2006. Chapter 184
  - www.microsurgeon.org Buncke clinic, on-line textbook

09 Burns Addn Contractures
Burn Reconstruction and Contractures of the Thumb
Kodi Azari, MD, FACS

Basic Principles
- Initial principles of acute burn care are similar to any other part of the body
  - Prevent Infection with Antimicrobial dressings
    - Silvadene, Ag, others
  - Optimize patient’s ability to heal
  - Early surgery for full-thickness skin injuries
    - Debride dead tissue
    - Wound closure based on injury
  - Maintain Function

Basic Principles
- Wound treatment
  - Risks of infection and need for motion out-weigh benefits of high tech dressings
  - Motion is critical. Aggressive ROM with aggressive pain management

Basic Principles
- The burn begins contracting at the time of injury
- The injury begins forming scar at the time of injury
- Scar Formation and Contraction continue for years
- That’s why Therapists are critical for Burn Management

Healing the Cutaneous Injury
- Deeper injuries require surgery to restore epidermis
  - STSG, FTSG
  - Sheet vs meshed grafts
  - Integra
  - Flaps

Excision and Skin Grafting
- When healing is not expected to progress without significant scar formation which limits function (2-3 weeks)
  - Decrease dead tissue load as soon as possible
  - Tangential excision
  - Pre-fascial excision

Courtesy Dr. Warren Garner, USC
Split Thickness Skin Graft

- Epidermis and partial thickness of dermis
- Transplant to viable wound bed
- Meshed vs. Sheet
- Full thickness grafts are rarely used except for secondary reconstruction

FTSG vs. STSG

- Durability: FTSG
- Flexibility: FTSG
- Sensation: FTSG
- Contraction: STSG > FTSG
- Take: STSG
- Donor Site: Depends
- FTSG with limited availability

Standard Skin Grafting

Graft Vascularization

Healing the Cutaneous Injury

- When wound bed does not support grafting, a more complex reconstruction is needed
- Classic surgical technique is vascularized tissue flap.
- Innovative solution is tissue-engineered matrix: Integra

Standard Grafting on Bone
Incomplete Vascular Ingrowth

Partial graft vascularization
Partial graft survival

Partial graft necrosis
Incompletely grafted wound

Grafting Integra on Bone

Sequential Integra Vascularization
Vascularized Integra Ready for skin grafting

Burn of hand with exposed MP joint and metacarpal

Burn of hand after Integra and skin grafting

Flap Reconstruction
- Exposed “white structures”
- Thoraco-epigastic flap
DELAYED RECONSTRUCTION
• Thumb-index web space
  – Most common problem after hand burn
  – Usually can fix with z-plasties or local flaps
• Loss of thumb length
  – Reconstruction depends on scarring in rest of hand

Main Go-To Technique

Contracture Release
Adductor release
Full Thickness Skin Grafts

– Thenar eminence
– 1st Web
– MCP and IP Joints
  • Thumb, Ring, and Small
– Soft tissue paucity

Before

After
• Contractures
  – All web spaces
  – Traumatic Syndactyly

LOCAL FLAPS
• Deepen first web space
• Many different types of flaps
  – Z-plasties
  – V-Y
  – W- Plasty
  – Jumping Man

Z- Plasty

LOCAL FLAPS
– Jumping Man
Reconstruction Algorithm

Grafts
Local flaps
Distal Flaps
Complex Reconstructions

Choices limited by extent of injury and available uninjured tissues
Index Ray Resection

• Common Injury pattern

Distraction Lengthening

First Web Contracture
POST-INJURY/SURGERY THERAPY

- The skin and wound have already begun to contract
- Aggressive early ROM when tissues are stable
- Splint when thumb is not moving
- Treat until normal, at decreasing frequency

10
Osteoarthritis
THUMB BASAL JOINT AND STT ARTHRITIS

BASAL JOINT OA: BACKGROUND
- especially post-menopausal women
- ligament laxity
  - anterior oblique (beak) ligament
- saddle joint becomes incongruous
- painful pinch/grip
- deformity

TREATMENT
- avoid forceful pinch
- trim nails
- oral nonsteroidals
- short opponens splint
- cortisone injection
- surgery

SURGICAL TREATMENTS
- Fuse or tighten or excise joint

Fusion
- Useful in young laborer with post-traumatic arthritis
- Thumb somewhat stiff
- Transfers stresses to scaphotrapezial joint
- Useful in primary OA

Tighten
- Eaton ligament reconstruction
- Useful for stage 1: cmc subluxation without arthritis
- Scope/shrinkage
- Osteotomy
**EXCISE**

unstable
weak
unstable and weak

1970’s: interpose soft tissue/silicone

---

**Excise and Interpose Tendon**

Dell, Brushart, Smith 1976:

- results identical w/wo tendon interposition
- radiographic space

---

**EXCISE AND INTERPOSE**

Swanson
maintains length, possibly pinch strength
25% dislocation rate (“…to be performed only by the surgically elite.”) Amadio, Millender, Smith 1982
simple excision vs. silicone implant: results identical

---

**EXCISE AND INTERPOSE IMPLANT**

- silicone spacer
- total joint replacement
- ceramic ball – NO!!

---

**SURGICAL TREATMENTS**

- Fuse or tighten or excise joint ~1950
- Excise and interpose 1970’s
- Excise and interpose and tighten 1980’s

---

**ARTELON**
FASCIAL ARTHROPLASTY: LRTI
(LIGAMENT RECONSTRUCTION TENDON INTERPOSITION)
(EXCISE AND INTERPOSE AND TIGHTEN)

“The procedure is technically more demanding than silicone implant arthroplasty.”
JHS 11A:330, 1986

LR WITHOUT TI
WEILAND, ET AL 1997
(excise and tighten without interposition)

Results same with or without tendon interposition
Advantage
- less incision on forearm
- technically easier
- Conclusion: tendon interposition not necessary

LR WITHOUT TI
WEILAND, ET AL 1997

HEMATOMA AND DISTRACTION ARTHROPLASTY

Hematoma and Distraction Arthroplasty
- Excise trapezium
- K-wire support for 5 wks in thumb spica splint/cast
- Ace bandage for few days
- Home exercises for 2 weeks
- Hand therapy if full motion not present
- Resume activities as tolerated, usually ~ 3 ms.

COMPARISON OF TWO YEAR RESULTS

% change from pre-op
- grip
- key pinch
- tip pinch
H D A 6-8 YEAR RESULTS

“long-term maintenance of a stable, pain-free thumb that has comparable strength and motion to published reports of the more complicated interventions over comparable time periods”

DAVIS: PROSPECTIVE, RANDOMIZED, CONTROLLED STUDY³

<table>
<thead>
<tr>
<th>Patients</th>
<th>Excise Trapezium</th>
<th>Pin PL</th>
<th>Interpose PL</th>
<th>Ligament reconstr</th>
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</thead>
<tbody>
<tr>
<td>1/3</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>1/3</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>1/3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

And the best result at 1 year?

All groups the same!!

HEMATOMA AND DISTRACTION ARTHROPLASTY
SUMMARY AND CONCLUSIONS

- Simple procedure
- No forearm scar
- Simple aftercare
- Extended recovery
- Good results

GOOD RESULTS, WHY?

All trapezial excision procedures
- local denervectomy
- hematoma arthroplasty
- inflammation and fibrosis

Hematoma and distraction arthroplasty
Less stiffness enhances arthroplasty

MINI TIGHTROPE

- No pins
- Early ROM
- Less subsidence

- More surgery
- Risk of fracture
- Impingement on 2nd mc base
- Results the same

STT ARTHRITIS
SCAPHOTRAPEZOTRAPEZOIDAL
BACKGROUND

- Second most common site of OA in the wrist
- Post traumatic?
- Rotatory subluxation of the scaphoid

READING


Instruction course Lect 2015;64:281-294

Arthritis of the thumb and digits: current concepts. Bernstein, R


Mohan A, Shenouda M, Ismail H, Desai A, Jacobs J, Sankhel T

11 Palsies, Tendon, Nerve TFS

Tendon Transfers for Nerve Palsies
The relocation of functioning muscle/tendon to replace injured/poorly functioning muscle/tendon

Nerve Transfers for Nerve Palsies
The relocation of a functioning nerve to replace injured/poorly functioning nerve

Muscle Physiology

- Force
- Excursion
- Work
- Line of Pull
Tendon Transfer Principles

- Match physiologic parameters of transferred muscle & tendon to injured muscle & tendon

Tendon Transfer Principles

- Recipient musculotendinous unit is more important to limb function than the donor unit
- One muscle, one function
- Transfer should have as straight a line of action as possible
- Muscle must have adequate excursion

Tendon Transfer Principles

- Preserve wrist tenodesis
- Tendon transfers in phase with donor function are optimal
  - Wrist extensors / digital flexors
  - Reconstructing the vector of the original muscle provides the best function for the transferred tendon

Nerve Palsies

- Radial
- Median
- Ulnar
- Combined Ulnar / Median

Operative Planning

- What works?
- What is available?
- What is needed?

Radial Nerve Palsy

- What is needed:
  - Finger extension
  - Wrist extension
  - Thumb extension
**Radial Nerve Palsy**

- **What is available:**
  - Median nerve innervated muscles
  - Ulnar nerve innervated muscles

**Radial Nerve Palsy**

- **Wrist extension:**
  - PT to ECRB
  - Thumb extension:
  - PL to EPL
  - Finger extension:
  - FCR to EDC (Brand)
  - FCU to EDC (Jones)
  - FDS (RF) to EDC (Modified Boyes)

**Radial Nerve Palsy**

- **Rehabilitation Immediately Post-op**
  - Long arm splint
    - Elbow 90° flexion
    - Wrist 20° extension
    - MP joints 30° flexion
    - IP joints complete extension

**Radial Nerve Palsy**

- **Rehabilitation 2 Weeks Post-op**
  - Below elbow splint
  - Hyperextension exercises
  - Hyperextension of MCP allows PIP flexion to avoid stiffness

**Radial Nerve Palsy**

- **Rehabilitation 4 Weeks Post-op**
  - Splint removed
  - Finger flexion exercises with a dynamic extension splint (2-3 weeks)

**Median Nerve Palsy**

- **What is needed:**
  - Thumb opposition
    - APB is most important muscle in producing thumb opposition
Median Nerve Palsy

- What is available:
  - Ulnar innervated muscles
  - Radial innervated muscles
  - High median innervated muscles (available with LOW, ie distal, median nerve palsy)

Low Median Nerve Palsy

- Thumb opposition and abduction is lost
- Thenar atrophy typical on PE

Low Median Nerve Palsy

- Thumb Opposition Tendon Transfers:
  - FDSIV to APB
  - EIP to APB
  - PL to APB (Camitz)
  - AbDM to APB (Huber) Congenital hypoplastic thumb

Low Median Nerve Palsy

- Camitz Transfer (PL to APB)

Low Median Nerve Palsy

- Rehabilitation
  - Thumb spica cast x 4 weeks
  - Thumb opposition
  - Wrist flexion for FDS & PL transfers
  - Wrist neutral for EIP & ADM transfers
**Low Median Nerve Palsy**

- **Rehabilitation**
  - 4 Weeks Post-op
  - Long opponens splint x 2 weeks
  - Splint removal for active thumb opposition exercises

---

**High Median Nerve Palsy**

- **Tendon Transfers**
  - Thumb opposition
    - EIP to APB
  - Index & middle flexion
    - ECRL to FDP 2/3 or FDP 4/5 to FDP 2/3
  - Thumb flexion
    - BR to FPL

**High Median Nerve Palsy**

- FDP 4/5 to FDP 2/3

---

**Low Median Nerve Palsy**

- **Rehabilitation**
  - 2 Months Post-op
  - Initiate strengthening program

---

**High Median Nerve Palsy**

- Splint for four weeks
  - Thumb opposition
  - Wrist neutral
  - MP flexion
  - Dorsal IP extension block
  - PROM digits
High Median Nerve Palsy

Rehabilitation
4 Weeks Post-op
- Active flexion exercises
- Start with place-and-hold exercises with wrist in flexion

High Median Nerve Palsy

Rehabilitation
6 Weeks Post-op
- Active wrist extension
- Active finger flexion

High Ulnar Nerve Palsy

Deficits
- Loss of ring / small finger flexion
  - FDP IV / V
- Loss of power pinch
- Clawing is NOT a significant factor

Low Ulnar Nerve Palsy

Functional Deficits
- Clawing
  - Intrinsic
- Loss of power pinch
  - Adductor pollicis
  - 1st dorsal interosseous
- Persistent abduction of small finger
  - Wartenburg's sign
**Ulnar Nerve Palsy**

*Rehabilitation Following Tendon Transfers to Reconstruct Power Pinch*

- **Immediately Post-op**
  - Short arm splint with thumb adducted against index finger
    - Wrist slightly flexed if FDS used
    - Wrist slightly extended if ECRB used

- **4 Weeks Post-op**
  - Removable hand splint holding thumb adducted
  - Gentle active exercises

---

**EPL Rupture**

- Distal Radius Fr
- RA
- Osteoarthritis
- Hardware

- EIP transfer
- Palmaris longus tendon graft
A word about motor nerve transfers

- Must be done within 1 year of injury
  - Motor endplates degenerate
- Like tendon transfers, donor nerves must:
  - Be expendable
  - Provide synergistic function
  - Transfer should be tension-free
  - Cut donor nerve as far distally as possible
  - Cut recipient nerve as far proximally as possible

Radial Nerve Palsy

- Median nerve branches used for transfer
- Median nerve branch to FDS \(\rightarrow\) ECRB nerve branch
- Median nerve branch to FCR/PL \(\rightarrow\) PIN

Median Nerve Palsy

- Radial nerve branches used for transfer
- ECRB nerve branch \(\rightarrow\) Pronator teres branch
- Supinator branch \(\rightarrow\) AIN

Ulnar Nerve Palsy

- Terminal branch of AIN used as donor as it inserts into pronator quadratus
- Restores intrinsic function
- Recipient is deep motor of ulnar nerve

Post transfer rehabilitation

- Immobilization is surgeon dependent (0 to 3 weeks)
- Begin passive ROM first, and “motor re-education” to simulate brain cortex
- Target muscle re-innervation can take several months
- Once present, focus on strengthening

Potential Advantages of Nerve Transfer over Tendon Transfer

- Less donor site morbidity (although both transfers use expendable tendons or nerves)
- Less post-op immobilization
- No risk of adhesions of gliding structures
- Minimal rehab needed
- Much more will be learned about nerve transfers
12 Tendon Injuries

Blood Supply to Tendons

Intrinsic
- intratendinous channels

Extrinsic
- vincula
- tenosynovium

Thumb Tendons Requiring Attention

Etrinsics
- Extensor pollicis longus
- Extensor pollicis brevis
- Flexor pollicis longus
- Flexor pollicis brevis
- Abductor pollicis longus
- Abductor pollicis brevis
- Opponens pollicis
- First dorsal interosseous

Extensor Pollicis Longus

- **Origin**: Middle 1/3rd of ulna
- **Insertion**: Base of distal phalanx
- **Action**: Extends IP and MCP joints
- **Innervation**: Post. Interosseous nerve (C7, 8)

Extensor Pollicis Longus

- Tightly restrained in 3rd dorsal compartment
- Lister’s tubercle
EPL Laceration

EPL Lacerations

- Zone TI: Over IP joint
- Zone TII: Proximal phalanx
- Zone TIII: Over MCP joint
- Zone TIV: First metacarpal
- Zone TV: Over wrist

Extensor Tendon Rehabilitation Generalizations

- Less gliding amplitude required than for flexors
- Immobilization
  - Duration depends on
    - Location of injury
    - Quality of tendon repair
- Static vs dynamic splinting protocols

Static Splinting Generalizations

- Static splinting x 4 weeks followed by AROM
- Passive ROM at 6 weeks
- Zone 3-8: Wrist 30° extension, MP and IP in full extension
- Zone 1-2: IP in full extension

Dynamic Splinting Generalizations

- Rubber band/outrigger setup
- Allow active flexion and passive extension
- Thought to be superior for zone 3 & 4 injuries
- Big burden, compliance doubtful

EPL Lacerations

Special Considerations for Rehab

Compared to other digital extensor lacerations
- Fewer joints
- Patient will naturally rehab self while using thumb
- Stiffness in extension not disabling
  - Some thumbs: <20° mp flxn naturally & full fn
Compared to digital flexor lacerations
- Fewer fascial constraints (no annular pulleys)
- Patient unlikely to simultaneously flex wrist and thumb
EPL Lacerations
Special Considerations for Rehab

Bottom line: go slowly
  – Adhesions less consequential than rupture

EPL Rupture

Etiologies:
  – Idiopathic
  – Over-use
  – Arthritis
  – Traumatic
  – Distal RadiusFx
  – Rheumatoid arthritis

Mallet Thumb

• Acute forceful flexion of thumb IP joint
• Avulsion of the EPL tendon with or without a bony fragment at its insertion
• Uncommon injury

Differentiate from
  • EPL rupture at wrist
  • Radial nerve palsy

EIP to EPL Tendon Transfer

Mallet Thumb

• Patients present in a slightly flexed posture and inability to extend IPJ
• Treatment
  – Non-operative: splint in extension
    • 6 weeks full time
    • 6 more weeks at night
  – Operative
    • Large bony avulsion (>40% fragment or displacement of >2mm)

EPL Rupture

• Differentiate from radial nerve palsy
• Treatment:
  – tendon transfer
    • EIP to EPL
    • EPB to EPL
  • Aftercare: wrist in extension for 3 weeks
  – transfer preferred over graft
**Flexor Pollicis Longus**

- **Origin**: Ant. surface of radius
- **Insertion**: Base of distal phalanx
- **Action**: Flexes thumb IP joint
- **Innervation**: Ant. Interosseous nerve from median n. (C8, T1)

**FPL Pulleys**

- A1 (MP joint), A2 (IP joint)
- Oblique pulley most important

**FPL Lacerations**

**Quick Review: Ideal Tendon Repair**

- Easy placement of sutures
- Secure knots
- Anatomic tendon end approximation
- Minimal interference with blood supply
- Strength to permit early motion protocols

**Quick Review: Repair Technique Strength**

- Strength of tendon repair proportional to number of strands:
  - 2 strand: 1800 g strength
  - 4 strand: 3600 g
  - 6 strand: 5400 g
- Increased # of strands increases repair bulk
- Epitenon suture increases strength 20-50%
- Repair strength diminishes 50% at 1 wk post-op, then gradually rises

**Quick Review: + Effects of Early Mobilization on Tendon Healing**

- Epitenon fibroblasts stimulated
- Fibroblast proliferation and maturation accelerated
- Increase in DNA & protein synthesis
- Pumping action of tendon motion forces synovial fluid into tendon enhancing nutrition
- Adhesions prevented/broken
FPL Lacerations
Special Considerations for Rehab

Compared to other digital flexor lacerations
- Fewer joints
- Repair is difficult, possibly tenuous
  (pulleys, thenar muscles, median motor branch)
- IP flexion strength more important than motion
  (ie, stiffness in slight flexion provides exc. fn)
- Stiffness at MP and/or IP: not disabling
  - Some thumbs naturally: <20° mp flxn, full fn
  - Full motion and strength at cmc likely preserved

FPL Lacerations
Special Considerations for Rehab

Bottom line:
1. advise patient that full motion is unlikely
2. advise patient that full motion is not necessary
3. advise patient that stiffness is better than rupture
4. advise patient of points 1,2,3 again and again

Go slowly with rehab

Flexor Tendon Protocols
Do They Translate to FPL?

- Immobilization
- Early Controlled Motion
  - Duran & Houser
  - Kleinert & Chow
- Active Mobilization
  - Silfverskold & May
  - Strickland

Immobilization Works

- Children
- Non-compliant adults

Which Means

- Be conservative with rehab even in compliant adults

FPL Rupture: Etiology

- After volar plating for distal radius fx
  - Prominent lip of plate
- Rheumatoid arthritis
  - Bone spur at scaphotrapezial joint
    (Mannerfelt lesion)

FPL Rupture

- Differentiate from anterior interosseous nerve palsy
  - (FDP<sub>i</sub> may not be weak)
- Treatment
  - Middle/ring FDS transfer if IPJ is good
    - Restores some motion and pinch strength
  - IPJ fusion if IPJ is damaged
    - Restores stability, not strength
Reading

- Flexor tendon lacerations
  http://www.emedicine.com/plastic/topic331.htm
- Extensor tendon lacerations
  http://www.emedicine.com/plastic/topic324.htm

13 Rheumatoid Thumb

Why is the thumb often well preserved in face of advanced rheumatoid deformities elsewhere?

Hand is sufficiently dysfunctional that thumb is not subject to deforming forces
Correct other abnormalities and thumb may deform!

The Thumb
In Rheumatoid Arthritis

Question...

What structures can go bad in RhA to cause thumb dysfunction?

- Skin: nodules
- Tendons:
  - Trigger finger: FPL
  - Tenosynovitis: EPL, EPB, APL, FPL
  - Rupture: especially EPL, FPL
- Joints: CMC, MP, IP
- Ulnar drift of other digits.....

What structures can go bad in RhA to cause thumb dysfunction?

- Ulnar drift of other digits
  - Pinch limited even with good thumb
  - Worse when thumb is also affected
**Skin**

**Rheumatoid Nodules**
- Can affect pulp of thumb
  - Generally do not raise skin but make pulp lumpy and limit manipulation of small objects

**Skin**

**Rheumatoid Nodules on Thumb**
- Nodules are diffuse and not readily excised
- Excise nodules when large and lumpy on critical tactile surfaces
- Downside
  - Reduced bulk of pulp
  - Reduced sensibility

**Tendons:**

**Triggering: FPL**
- Symptoms
  - Snapping/grinding, awkward; usually **w/o pain**
- Exam
  - Crepitation or triggering, dysrhythmic motion, thickening, weakness, **minimal tenderness**
- Treatment
  - Cortisone injection
  - **Tenosynovectomy**

(BOLD = different than idiopathic trigger digit)

**Tendons:**

**Flexor Tenosynovitis**
- Leads to crepitation, CTS, tendon rupture
- Treatment: tenosynovectomy, early therapy

**Flexor Tendons:**

**Rupture**
- Mannerfelt lesion
  - Synovitis at scaphotrapezial joint
  - Sharp bone edge protrudes into carpal canal
  - Rupture of FPL, FDP to index
  - Must differentiate from ant. inteross. n. palsy
Flexor Tendons: Rupture
- Mannerfelt lesion
  - Treatment
    - Remove bone spurs
    - Fuse thumb IP (rely on intrinsics to flex MP)
    - Tendon transfer FDS\textsuperscript{i} to FDP\textsuperscript{i}

Tendons: Dorsal Tenosynovitis
Soft mass proximal/distal to ext. retinaculum
When synovium glides with tendon excursion:
- Synovium is invading tendon
- Rupture can be anticipated
- Plan pre-emptive tenosynovectomy

Tendons: Dorsal Tenosynovitis
\textbf{EPL rupture:} attrition rupture, end-end repair not possible
EIP transfer (preferred) or tendon graft
EPB and APL may rupture, but would generally go undiagnosed in face of other joint and tendon problems

Joints: Interphalangeal (IP)
- Treatment: joint fusion (arthrodesis)

Joints: Metacarpophalangeal (MP)
- Unstable in radial deviation (gamekeeper's/skier's thumb)
- Treatment depends on joint surfaces:
  - Good: ligament reconstruction
  - Bad: fuse
  - Implants unstable

Joints: Interphalangeal (IP)
- Stiff in extension or flexion: awkward
- Unstable in radial deviation or in all directions (flail): functionally = amputation
### Joints: Metacarpophalangeal (MP)
- Stiff in flexion or hyperextension
- Treatment: depends on adjacent joints, stay tuned……..

### Joints: Carpometacarpal (CMC)
- Stiff in adduction
- Rarely painful
- Treatment:
  - Resection arthroplasty

### Rheumatoid Thumb Deformities Classification System
**Warning**
- The classification system is confusing
- Type 1 is far and away the most common deformity, then Type 3
**Suggestion**
- Learn about Types 1 and 3
  - Useful for understanding all digital collapse patterns
- Save the Classification Table
  - Ask somebody you don't like to memorize it
    - Watch them go mad

### Type I Rheumatoid Thumb
1. **Synovitis** at MP weakens dorsal capsule and insertion of EPB: weakens MP joint extension
2. **EPL** subluxes ulnarily and volarly: flexes MP and extends IP

### Type I Rheumatoid Thumb Outcome: Boutonniere Deformity
3. MP and IP collapse further with forceful pinch
4. Deformities become fixed
5. Pulp inaccessible to index and middle fingers, limiting small object manipulation and wide grasp

### Type III Rheumatoid Thumb
1. Synovitis at CMC leads to subluxation
2. Adductor pollicis contraction/spasm/fibrosis causes adduction contracture
Type III Rheumatoid Thumb

Outcome: Swan Neck Deformity

3. Subluxed, adducted metacarpal causes
   MP hyperextension
   IP flexion

Rheumatoid Thumb Classification
(for masochists)

<table>
<thead>
<tr>
<th>Type</th>
<th>CMC joint</th>
<th>MP joint</th>
<th>IP joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>uninvolved</td>
<td>flexed</td>
<td>extended</td>
</tr>
<tr>
<td>II</td>
<td>flexed, addn</td>
<td>flexed</td>
<td>extended</td>
</tr>
<tr>
<td>III</td>
<td>subluxed</td>
<td>extended</td>
<td>flexed</td>
</tr>
<tr>
<td>IV</td>
<td>flexed, addn</td>
<td>ucl unstable</td>
<td>uninvolved</td>
</tr>
<tr>
<td>V</td>
<td>+/- involved</td>
<td>hyperextn</td>
<td>uninvolved</td>
</tr>
<tr>
<td>VI</td>
<td>bone loss at any level (arthritis mutilans)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quiz…

Quiz!!
Classification of Rh Thumb Please

Arthritis mutilans
Type 6

Non-Operative Management
for Multi-Joint Rheumatoid Thumb Deformities

• Stabilizing splints
  – not particularly effective
  • Render thumb immobile
  • Cover tactile surfaces

Non-Operative Management

• Joint protection program
  – Grasp with two hands, e.g., pans on stove
  – Protect MP joints from ulnar drift
  • Jar lids off with left hand, on with right hand

Non-Operative Management

• Joint protection program
  – Avoid forceful grip and pinch where possible

bad
good
Non-Operative Management
- Joint protection program
  - Provide aids for forceful grip and pinch activities

Operative Management
- Requires attention to CMC, MP, and IP
  - CMC soft tissue arthroplasty
  - MP
    - Tendon rebalancing if joint is OK
    - Fusion if joint is bad and IP is OK
  - IP
    - Fusion if MP is OK

Operative Management
- What if all three joints are bad?
  - Soft tissue arthroplasty at CMC
  - Fusion vs. silicone arthroplasty at MP
  - Fusion at IP
- Less commonly indicated with current anti-rheumatoid medications and good joint protection program

Reading

14 Thumb Reconstruction
6 essential qualities of a functional thumb
- mobile
- opposable
- sensate
- shapely
- stable
- strong

MOSSSS
How Thumbs Go Bad

- Congenital
  - duplication/polydactyly
  - hypoplasia/aplasia
  - constriction band syndrome
- Traumatic

### Congenital Anomalies

#### Duplication

- MOSSSS:
  - mobile, opposable, sensate, shapely, stable, strong

#### Hypoplasia/Aplasia

- mild, medium, marked
  - MOSSSS:
    - mobile, opposable, sensate, shapely, stable, strong

#### Marked Hypoplasia/Aplasia

- Absent thumb
- Floating thumb

- MOSSSS
Marked Hypoplasia/Aplasia

Mild Hypoplasia

MOSSSS
Huber transfer of
Abductor digiti minimi

Moderate Hypoplasia

MOSSSS
Decision more difficult
than with marked or mild
hypoplasia

Congenital Amputations
Constriction Band Syndrome

MOSSSS
on-top plasty or toe transfer

Thumb Injuries

- direct repair when possible
  - fractures, dislocations
  - lacerations
    - skin, nerve, tendon
- limited tissue loss
  - grafts/flaps

FLAPS

V-Y advancement
Moberg advancement
distant pedicle
Thumb Injuries

- direct repair when possible
  - fractures, dislocations
  - lacerations
    - skin, nerve, tendon
- limited tissue loss
  - grafts/flaps
- extensive tissue loss
  - replant when possible

MOSSSS
mobile, opposable, sensate, shapely, stable, strong

Prostheses

MOSSSS?

Thumb Injuries

- direct repair when possible
- limited tissue loss
  - grafts/flaps
- extensive tissue loss
  - replant when possible
  - reconstruct

Lengthening
By Distraction

MOSSSS
Lengthening On-Top Plasty

What’s going on here?

Pollicization

Second Toe Transfer (Free Flap)

What’s going on here?

First Toe Transfer
What to do? Severely crushed thumb and base of index finger.

Partial First Toe Transfer (wrap around)

Review How Congenitally Bad Thumbs Get Better

- duplication/polydactyly
  - reduce
- hypoplasia/aplasia
  - augment/pollicize
- constriction band syndrome
  - on-top plasty, toe transfer

Review How Traumatically Bad Thumbs Get Better

- repair/replant
- lengthen
  - on-top plasty
  - distraction
  - pollicization
  - toe transfer

Reading:
http://www.emedicine.com/orthoped/topic568.htm

15 Quiz & Closing Comments

Reinforcement Quiz

1. Trigger thumbs are more common
   A. in adults than children
   B. than triggers in other digits on same hand
   C. than triggers in other digits on the opposite hand
   D. after pregnancy and delivery
   E. in men than women

2. For sharp amputations, surgeons generally try to replant thumbs when the injury is
   A. at any level
   B. proximal to the MP joint
   C. proximal to the IP joint
   D. through the nail

3. Thumb MP joint dislocations are more common than IP joint dislocations because
   A. collateral ligament strength
   B. configuration of the joint surfaces
   C. length of lever arm
   D. pull of extrinsic tendons
   E. relative skin laxity
4. A thumb mp joint grade 3 ulnar collateral ligament tear implies
A. associated avulsion of the EPL insertion
B. associated grade 2-3 tear of radial collateral ligament
C. onset of early post-traumatic arthritis
D. significant damage to both digital arteries

5. Joint subluxation following a Bennett fracture-dislocation is caused by
A. gravity when the patient is standing
B. unresisted pull of the APL tendon
C. unresisted pull of the FPL tendon
D. incongruity on the distal scaphoid surface
E. spasm in the thenar muscles

6. Which joint has the most person-to-person variability of natural ROM?
A. glenohumeral joint
B. thumb IP joint
C. thumb CMC joint
D. thumb MP joint
E. scaphotrapezial joint

7. Transferring the second, rather than the first toe for thumb reconstruction
A. provides a normal appearing thumb
B. provides a nearly normal appearing foot
C. provides better two-point discrimination
D. provides a faster rehabilitation time
E. does not require nerve repair

8. A patient w/ rheumatoid arthritis loses active extension of small finger mp joint. Left untreated, a likely consequence is
A. loss of flexion of the small finger mp joint
B. loss of extension of the small finger pip joint
C. loss of extension of the ring finger mp joint
D. diminished sensation in the ulnar nerve distribution
E. onset of flexor tendon triggering in multiple fingers

9. Now 6 months after volar plating for a distal radius fracture, the patient cannot actively flex her thumb IP joint. The likely cause is
A. an unrelated anterior interosseous nerve palsy
B. a trigger digit locked in extension
C. carpal tunnel syndrome
D. tenosynovitis caused by allergy to the implanted hardware
E. FPL rupture on prominent hardware

10. Transferring the EIP for a ruptured EPL tendon makes sense because
A. it is expendable
B. it runs a similar course
C. its strength approximates the EPL
D. its excursion approximates the EPL
E. all of the above

11. The Tightrope procedure for OA at the CMC joint may
A. allow for early return to pinch activities
B. require long forearm scars
C. cost less than a simple trapezial excision
D. prevent contact between the 1st and 2nd mc bases

12. Following release of a first web adduction contracture
A. a split thickness skin graft is better than a full thickness graft
B. a full thickness skin graft is better than a split thickness graft
C. a split thickness skin graft is better than a distant flap
D. a split thickness skin graft is better than a local flap
E. healing by dressing changes and wound contracture is best

13. Sesamoid bones, often seen on thumb x-rays, are in the
A. volar plate of the MP joint
B. volar plate of the IP joint
C. FPL tendon at the A1 pulley
D. FPL tendon at its insertion
E. distal half of the trapezium

14. How many muscles control the thumb?
A. 4 extrinsics and 5 intrinsics
B. 5 extrinsics and 4 intrinsics
C. 3 extrinsics and 3 intrinsics
D. 5 superficial and 5 deep
E. 5 flexors and 5 extensors

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On Monday, complete the quiz and evaluation form at www.doctorsemystify.com and receive your CE certificate.