

Hand Mobility Deficits

ICD-9-CM codes: 882.2 Open wound of hand with tendon involvement
 883.2 Open wound of finger with tendon involvement

ICF codes: Activities and Participation code: **d4301** Carrying in the hands; **d4401** Grasping; **d4452** Reaching; **d4453** Turning or twisting the hands or arms
Body Structure code: **s73028** Tendon structures of hand
Body Functions code: **b7101** Mobility of several joints

Common Historical Findings:

Trauma – e.g. forceful finger flexion while the finger is extending

Common Impairment Findings - Related to the Reported Activity Limitation or Participation Restriction:

Effusion or pain

Unable to voluntarily move isolated joint

Physical Examination Procedures:

Loss of isolated joint active mobility

Full isolated joint passive mobility

Wrist Mobility Deficits: Description, Etiology, Stages, and Intervention Strategies

The below description is consistent with descriptions of clinical patterns associated with finger
Flexor Tendon Laceration or Repair the vernacular term “**Tendon Laceration or Rupture**”

Description: When an outside sharp or blunt force is struck on the plantar surface of the hand, a complete or partial rupture of the flexor tendon and/or retinaculum can occur. With severe laceration, tendon exposure and swelling maybe observed. The involved digit will assume an extension posture while the wrist is in neutral position. Tenodesis functional grip may not occur. Injuries to Zone II of the hand has worse prognosis due to flexor sheath and vascular disruption to the FDS and FDP tendons.

Etiology: This can occur while holding a sharp object for cutting, falling onto a sharp object with outstretched hand, or a crush injury from heavy mechanical loading and other extensive trauma.

Non-operative versus Operative Management: Most patients will agree to surgery to restore hand function to highest level. Complications from non-operative plan can result in contractures and loss of hand function. Improved outcome results from surgery and conservative rehabilitation and splinting to ensure tendon healing and decreased risk of rupture. Immediate repair and delayed primary repair can improve prognosis pending on the goals and prior level function of patient. Alternative surgery such as grafting can involve less extensive operations, decreased disability, and improved tendon length. Contraindications include infections, loss of palmar skin over flexor organization, and damage of flexor retinaculum.

Surgical procedure: The degree of repair and procedure depends on the surgeon and the quality of the involved tendon(s). Operative assessment include the quality of the pulley system, damage of surrounding vascular and nervous supply, damage of tendon and edges of tendon, and indicative tendon suture techniques. The type of surgery and outcome depends on the zone classification and its structures involved. Primary repair of tendons include excision of frayed or damaged tendon edges and suturing the edges. Free grafting can also be used to extend the tendon. If severe adhesions result after 3 months of rehabilitation and a range of motion (ROM) plateau, tenolysis surgery can be utilized to excise the adhesions to increase tendon gliding. Also, stage I and II flexor reconstruction is necessary if severe pulley and tendon destruction occurred in zone I and II. The graft can be taken from palmaris longus or toe extensor tendons, with two stages for silicon implant for adherence and implantation. Three months is allotted between the stages, where rehabilitation can take up to 12 weeks.

Preoperative Rehabilitation:

- Bracing for support and decreased risk of contractures
- Edema and pain management
- Patient education and rehabilitation plan

Acute Stage / Severe Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.3** SEVERE impairment of mobility of several joints*

- Swelling and ecchymosis around the involved tendon and/or the entire hand
- Loss of isolated active mobility of the DIP and/or PIP joint flexion
- Loss of isolated passive mobility of the DIP and/or PIP joint flexion
- Severe tenderness to palpation of the flexor tendon

Sub Acute Stage / Moderate Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.2** MODERATE impairment of mobility of several joints*

As above, except:

- Moderate swelling
- Moderate loss of isolated active / passive mobility of the DIP and/or PIP joint flexion
- Moderate tenderness to palpation of the flexor tendon

Settled Stage / Mild Condition: Physical Examinations Findings (Key Impairments)

*ICF Body Functions code: **b7101.1** MILD impairment of mobility of several joints*

As above, except:

- Mild swelling
- Mild loss of isolated active / passive mobility of the DIP and/or PIP joint flexion
- Mild tenderness to palpation of the flexor tendon

Intervention Approaches / Strategies

Postoperative Rehabilitation

Acute Stage / Severe Condition: Weeks 0-3

Goals: Protect tendon repair and enable collagen synthesis

- Immobilization (for individuals with impaired cognition and under the age of 10 years)
- Early controlled passive ROM (pending on surgeon)
- Splinting: Wrist flexion 10-30° flexion, MP joints 40-60° flexion, and IP joints neutral with dorsal blocking position; removed at least once a week during therapy
- Therapy 1-5 times a week: Wound care, edema control, scar massage, active extension with passive supported flexion, Duran and Houser's controlled passive gliding technique

Sub Acute Stage / Moderate Condition: Weeks 3-5

Goals: Initiate active motion to achieve full range of motion

- Initiate active flexion - blocking exercises, differential tendon gliding

Settled Stage / Mild Condition: Weeks 6-8

Goals: Initiation of strengthening and functional activities to return to work

- Resistance exercises pending on adhesion quality (Lack of adhesions do not provide adequate support; severe adhesions indicate very light resistance)
- Light prehension, isometric strengthening, sustained grasp, ADL's with assist
- Dynamic extension splint prn
- After 8 weeks – grip, heavy resistance, and work hardening exercises

Selected References:

Coony W, Lin G. Improved tendon excursion following flexor tendon repair. *J Hand Surg* 12B:96, 1987.

Mackin E, Callahan A, Hunter J. Primary Care of Flexor Tendon Injuries. *Rehabilitation of the Hand and Upper Extremity*. St. Louis, Mosby, 2002.

Stanley B, Tribuzi S. *Tendon Injuries: Concepts in Hand Rehabilitation*. Philadelphia, Davis, 1992.

Strickland JW. Flexor Tendon Surgery. *J Hand Surg*. 1989;14B:368-382.

Verdan C. Primary and secondary repair of flexor and extensor tendon injuries. *Hand Surgery*. Baltimore, Williams & Wilkins, 1966

Wrist Mobility Deficits: Description, Etiology, Stages, and Intervention Strategies

The below description is consistent with descriptions of clinical patterns associated with finger
Mallet Finger the vernacular term “**Tendon Laceration or Rupture**”

Description: A tear or rupture of the extensor tendon mechanism at or near the distal phalanx (Zone I and II). The resultant deformity is an extension lag at the DIP joint. The extensor lag may not be noted for several days. Patient will demonstrate the inability to extend the involved finger actively. It can also cause an avulsion fracture at the insertion of the extensor tendon on the distal phalanx as well as hyperextension of the PIP joint. Radiographs consisting of AP, lateral, and oblique views are used to rule out avulsion.

Etiology: Direct blow that forcibly flexes an extended finger. The underlying forces of a Zone I extensor tendon injury which have been reported are: 1) a fingertip is struck by a ball, 2) stubbing a finger during bed making and 3) elderly people pulling on their socks.

Mallet Finger Classification:

- o Type I (most common): Closed trauma, tendon is damaged with no fractures or a small avulsion fracture. Injury of extensor tendon mechanism.
- o Type II: Rupture of the tendon near or at the DIP joint.
- o Type III: Deep abrasion of the tissues, open injury.
- o Type IV: Injury to trans-epiphyseal (growth plate) in children and fractures involving a large (greater than 20%) part of the joint surface in adults.

Operative versus Non-operative Management: Surgical repair is typically reserved for patients with an open injury or more severe injuries. It may involve sutures to the tendon, fracture reduction and fixation or correction of a deformity. Operative methods may consist of an internal percutaneous fixation such as a Kirschner wire, mini screws or tension band wiring with a stainless steel wire and arthrodesis. Surgical complications include: pain, infection, skin irritation, nail deformity, joint incongruity, impaired sensation, skin necrosis, scar tenodesis, pulp fibrosis and decreased flexion of the DIP joint. Indications for non-operative management includes type I mallet finger injury with the skin intact.

Conservative treatment involves splinting the DIP joint in hyperextension 24 hours a day for 6-8 weeks followed by overnight splinting for 4 weeks prn. Positioning the DIP in extension relaxes the extensor tendon and aligns the torn tendon or fractured fragments to promote healing. Considerations for management include: skeletal maturity with serious consideration needs to be given to epiphyseal fracture in children and rheumatoid arthritis, occupation, digit injured, type of injury, time since injury, loss of extension, functional disability, pain, inconvenience and previous treatment. Splinting options are: 1) Stack splint which is difficult to remove and reapply for hygiene, 2) Perforated custom-made splint which has a lower incidence of treatment failure, 3) Padded Aluminum-allow malleable finger splint known to have fewer complications and 4) Abouana splint which requires frequent replacing of rubber cover and lacerations from it's exposed wire. Considerations for choice of design are: convenience of application and use, comfort and tolerability and complication avoidance.

Surgical Procedure: Surgical procedures are more often performed when the patient has an open injury with a bony avulsion that is irreducible or involve one third or more of the articular surface, or volar subluxation of the distal phalanx, or is past the acute stage of 10 days, or a failed conservative treatment. Ruptured tendons may be repaired with fine braided non absorbable sutures. Caution must be considered due to an avascular critical zone where the tendon is compressed over the head of the middle phalanx during flexion which will influence the healing phase. The Kirschner wire is surgically placed through the DIP and PIP to reunite the tendon and align the fragmented bone by stabilizing the distal joint in neutral or slight extension. The distal wire compresses the fracture site and prevents dislocation of the tendon and fragment. Arthrodesis is a surgical fusion placing the DIP joint in full extension and is sometime done as a last measure.

Preoperative Rehabilitation:

- Acute wound protocol
 - Wound cleansing and dressing
- Remove restrictive jewelry
- Control inflammatory response
 - Elevation, ice, compressive dressing, manual lymphatic drainage
- Option to splint prior to surgery
 - Follow non-operative treatment intervention.

Acute Stage / Severe Condition: Physical Examinations Findings (Key Impairments)

ICF Body Functions code: b7101.3 SEVERE impairment of mobility of several joints

- Swelling and ecchymosis around the involved tendon and/or the entire hand
- Loss of isolated active mobility of the DIP joint extension
- Severe tenderness to palpation of the flexor tendon

Sub Acute Stage / Moderate Condition: Physical Examinations Findings (Key Impairments)

ICF Body Functions code: b7101.2 MODERATE impairment of mobility of several joints

As above, except:

- Moderate swelling
- Moderate loss of isolated active / passive mobility of the DIP and/or PIP joint extension and/or flexion
- Moderate tenderness to palpation of the flexor tendon

Settled Stage / Mild Condition: Physical Examinations Findings (Key Impairments)

ICF Body Functions code: b7101.1 MILD impairment of mobility of several joints

As above, except:

- Mild swelling
- Mild loss of isolated active / passive mobility of the DIP and/or PIP joint extension and/or flexion
- Mild tenderness to palpation of the flexor tendon

Intervention Approaches / Strategies

Non-Surgical Rehabilitation

Acute Stage / Severe Condition: Weeks 1-6

Goals: Control inflammatory response and swelling
 Reduce infection risks and skin breakdown
 Compliance in splinting regimen
 Demonstrate awareness of the consequences of non-compliance

- Application of appropriate splint that maintains the DIP joint in hyperextension.
- Splint to be worn 24 hours per day for 6 weeks.
- Non-compliance requires returning to beginning of 6 week regime.
- Elevation, ice, compression, manual lymphatic drainage.
- Instruction and demonstration donning and doffing splint while maintaining the DIP joint in hyperextension.
- Instruction and demonstration of proper hygiene during splint removal.

Sub Acute Stage / Moderate Condition: Weeks 6-10

Goals: Restore tendon continuity
 Maintenance of skin integrity
 Restore mobility and function without re-rupture of tendon

- Radiograph clearance as needed.
- Patient education for skin integrity.
- Finger active flexion exercises – blocking, composite, tendon gliding
- Education in night splinting for 4 weeks prn.
- Functional finger flexion activities.

Settled Stage / Mild Condition: Weeks 10-12

Goals: Full restoration of tendon continuity
 Ongoing maintenance of skin integrity
 Full mobility and function

- Non-restoration requires orthopedic physician referral.
- Patient demonstrates the proper management of skin integrity.
- Home exercise program to restore and maintain finger flexion without re-rupture of tendon.

Postoperative Rehabilitation

Acute Stage / Severe Condition: Weeks 1-6

Goals: Reduce infection risk
Control inflammatory response and swelling
Joint support and repair protection

- Patient education in skin integrity
- Elevation, ice, compression, manual lymph drainage
- Splinting in hyperextension

Sub Acute Stage / Moderate Condition: Weeks 6-8

Goals: Reduce residual symptoms for infection risk, edema and pain
Joint support for ongoing healing.
Increase DIP joint flexion.

- Patient education in skin integrity, elevation and ice.
- Splinting DIP joint in slight extension.
- DIP active range of motion with splint removed.

Settled Stage / Mild Condition: Weeks 8-12

Goals: Restore functional movements
Reduce risks of re-injury
Normalize scar tissue mobility
Restore full range of motion.

- Function mobility - finger flexion to distal palmar crease
- Scar tissue mobilization at surgical site to reduce adhesion and improve skin integrity.
- Active range of motion for DIP flexion – blocking, composite, tendon gliding
- Splinting if extension lag is present

Selected References:

Handoll HHG, Vaghela MV. Interventions for treating mallet finger injuries. *The Cochrane Database of Systematic Reviews*. 2004 n3.

Hunter J, Mackin E, Callahan A. Rehabilitation of the Hand: Surgery and Therapy. *The Extensor Tendons: Anatomy and Management*. St. Louis, Mosby, 2002.

Perron AD, Brady W, Keats T, Hearsh R. Orthopedic Pitfalls in the Emergency Department: Closed Tendon Injuries of the Hand: *Am J of Emergency Med*. 2001;19:1: 78-80.

Wang Q, Johnson B. Fingertip Injuries: *American Family Physician*. 2001;63:10.