



## **Standard of Care: Flexor /Extensor Tendon Laceration of the Forearm, Wrist, Digits**

### **Case Type / Diagnosis:**

This standard applies to patients who have undergone surgical repair of flexor and/or extensor tendon injuries of the hand and/or wrist. Common mechanisms of injury include, but are not limited to: accidental laceration with broken glass, kitchen knives or table saws, motor vehicle accidents, crush injuries, and suicide attempts.

### **ICD-9 codes:**

883.2	Open wound finger with tendon involvement
882.2	Open wound hand with tendon involvement
881.22	Open wound wrist with tendon involvement

### **Indications for Treatment:**

- Knowledge deficit regarding wound care, home exercise program and post-operative movement precautions.
- Need for protective positioning, generally via fabrication of a custom thermoplastic splint. Specific design depends on tendons injured, zone of injury, type of repair, postoperative protocol and patient sophistication. Generally, splints are designed to prevent tension on the tendon repair while allowing for carefully prescribed passive and/or active exercise.
- Upper extremity edema, pain, joint stiffness, poor tendon excursion, decreased range of motion (ROM), and weakness.
- Functional impairment in the areas of self-care, home, community, leisure and work activities.
- Decreased skin integrity (wound/incision with risk for infection and scarring)

### **Contraindications / Precautions for Treatment:**

- Consider whether vincula (flexor tendons) or mesotendons (extensor tendons) were damaged. Vincula provide 70% of nutritional support to flexor tendons in zones 1 and 2.<sup>1</sup> Mesotendons provide 30% of nutritional support to the extensor tendons via vascular perfusion in all zones. Synovial diffusion provides the remaining 70%. (p449 rehab of the hand)

- Consider any fractures, pulley, nerve and/or artery repairs that may require a longer immobilization phase or other modifications to the program.<sup>2</sup>
- Therapist must assess the patient's cognitive status to determine ability to understand and comply with a complex home program.
- Monitor for any signs of infection. Report positive findings to referring MD immediately. Send to emergency room if referring MD is not available.
- Consider specific details of the tendon repair (e.g. number of strands, type of suture, whether epitenon/tendon sheaths were repaired.) Repair of epitenon adds 10-50% strength to the repair and reduces gap formation.<sup>3</sup>
- Consider that immediately after surgery, postoperative edema and inflammation will increase the stress placed on the tendon repair site with active motion. Therefore, it is advised to wait at least 72 hours before initiating any active motion of the repaired tendon. (page 452 Rehab of the hand)
- Consider that biomechanically, the immobilized tendon loses strength after repair: 50% at the end of week one, 33% at the end of week three, and 20% at the end of week six.<sup>4</sup> Tendons that move as they heal have better motion and strength than those that do not move. The difference is not improved by adding a load over and above the amount needed to initiate tendon gliding.<sup>3</sup>

## **Evaluation:**

**Medical History:** Review medical history questionnaire and/or patient's computer Longitudinal Medical Record (LMR). Review any diagnostic imaging tests, work up and operative reports. Pay specific attention to any medical problems or medications that may influence healing, and previous injuries to the same extremity.

**History of Present Illness:** Interview patient to review medical history. When the patient is unable to give a full history, interview patient's legal guardian or custodian. Review mechanism of injury, noting the position of the extremity at time of injury, whether it was a tidy vs. untidy wound, the timing of repair, any reason for delay in surgery, and any concomitant injuries.<sup>2</sup> Determine any past injuries that may be relevant (e.g. history of previous trauma and/or wrist/hand joint related problems.) Thoroughly review the operative report to determine the underlying integrity of the repair. Specifically note the type of suture, number of strands, and type of knot used.<sup>1</sup> For flexor tendon repairs, any four-strand core stitch repair with circumferential epitendinous suture should permit light composite digital flexion during the entire healing period.<sup>3</sup> Keep in mind that sutured extensor tendons are 50% as strong as flexor tendons, due to their reduced dimension and collagen cross-linking.

**Medications:** Note names, dosages and purposes of medications taken. Common analgesics prescribed include Vicodin and Percocet. Nonsteroidal anti-inflammatories (NSAIDs) are generally not prescribed as they can delay healing. Antibiotics may be prescribed as a post-operative precaution.

**Social History:** Review patient's home, work, recreational interests and social situation. Determine whether patient will have assistance at home and modify home program

instructions accordingly. Note any upper extremity weight bearing, reaching, lifting or carrying activity that patient typically performs with activities of daily living (ADLs).

## **Examination:**

This section is intended to capture the most commonly used assessment tools for this case type/diagnosis. It is not intended to be either inclusive or exclusive of assessment tools.

**Pain:** Level of pain may be measured on the Visual Analog Scale (VAS), and/or the Verbal Rating Scale (VRS). Note location and quality of pain, as well as activities and/or positions that relieve or exacerbate symptoms.

**Visual Inspection:** Note degree of healing of incisions/wounds and presence of sutures. Note the resting position of involved digits. Look for signs of tendon avulsion via presence or absence of normal cascade during passive tenodesis exercise.

**Wound assessment:** (Based on American Society of Hand Therapists (ASHT) guideline -- see attached.) Note wound location, size, color, integrity of tissue, any drainage (quantity, quality and color), erythema, edema, odor, and the temperature and vascularity of tissues.

**Palpation:** Palpate the entire wrist/hand/forearm. Focus on the presence of edema.

**ROM:** Assess active and passive ROM of all involved joints not restricted by post-operative precautions. Typical post-operative precautions limit or prohibit immediate active and/or passive tension on the repaired tendons.

**Strength:** Strength is not formally assessed until after post-operative week eight. Must differentiate between poor tendon glide due to adhesions, and true muscle weakness. Severe weakness results in limited AROM. Excursion problems due to tendon adhesions will also limit AROM, but the tendon will be able to take significant resistance at its end range.

**Sensation:** Perform brief sensory screening via light touch assessment along dermatomes. With history of nerve injury, if any trophic changes are observed, and/or if subjective assessment is abnormal, then sensory evaluation with Semmes-Weinstein monofilaments is indicated (see separate sensibility testing procedural standard of care).

**Posture/Alignment:** Assessment will primarily focus on the hand and upper quarter positioning in relation to the patient's overall posture (ex. need to issue or discontinue a sling).

**Edema assessment:** Evaluate edema via circumferential measurements, noting anatomic landmarks and comparing to uninvolved side. Typical landmarks include the volar wrist crease, 10 cm proximal to wrist, around MCPs 2-5, and either at or between the IP joints of the digits. Volumetric measurements may be taken as necessary and appropriate.

**ADL function:** Interview patient regarding self-care, home, work, leisure and child care responsibilities, and note any functional impairments. Evaluate directly with specific ADL tasks when indicated. Note available family/friend assistance, and identify any needs for additional services (ex. HHA, homemaker). The use of a functional outcome measure such as the QuickDash is used to objectively assess functional status.

**Proximal UE/Cervical screen:** Screen proximal upper extremity (UE) and cervical screen, noting A/PROM, sensory screening via light touch assessment along dermatomes, and note reports of pain and/or paresthesias. This screen is particularly important in cases of high-energy trauma (ex. MVA).

**Positioning/Splint needs:** Assess postoperative positioning orthosis to ensure proper position of joints involved and proper fit. Assess patient's ability to don/doff orthosis, maintaining post-operative precautions. Fabricate/modify a custom removable splint when appropriate. (See specific tendon protocols for position of wrist/digits.)

**Differential Diagnosis:** not applicable

### **Assessment:**

Therapy is usually initiated at 1-5 days post surgical repair. Immediate needs for therapy include wound care, edema management, splint fabrication, patient education regarding post-operative precautions, and initiation of ROM if appropriate.

Skilled post-operative care provided by an experienced hand therapist is essential for maximal healing and functional recovery after tendon repair surgery. Failure to safely mobilize the repaired tendon will result in dense scar adhesion formation and ultimate loss of function, while overzealous mobilization of the repaired tendon via active and/or passive motion will result in gap formation and/or tendon rupture.

#### **Potential Problem List**

- Pain
- Edema
- Decreased ADL Function
- Decreased ROM
- Sensory Deficit
- Strength Deficit
- Knowledge Deficit
- Skin Integrity Deficit (risk for non-healing, infection, scarring)

**Prognosis:** Prognostication is dependent upon many factors including: type and severity of injury, timing of repair, age and health of patient, and ability of patient to understand and follow through with program/precautions.

- Complex injuries (involvement of bone, tendon, nerve and vessel) have a poorer prognosis than simple lacerations.
- Complete recovery of motion is more likely with extensor versus flexor tendon injuries.
- Simple extensor tendon injuries should be able to achieve 90-100% of normal AROM.
- A fifteen-year review of clinical outcomes of flexor tendon repairs reported excellent or good (at least 125 degrees IP AROM, according to the Strickland system) functional return in over 75% patients.<sup>7</sup>
- Factors that negatively affect prognosis include: decreased patient compliance, post-operative infection, concurrent fracture, neurovascular, and/or pulley injury, and delayed repair (7-10 days).
- If the lacerated tendon is suspected by a therapist and has gone undetected the referring physician must be notified immediately to make an appropriate surgical decision. If the patient is referred by a general physician, than a hand specialist may need to be consulted.

**Typical Treatment Goals:**

- Independent with home program including: donning/doffing of orthosis, controlled ROM program, and wound care.
- Independent with all self-care activities at discharge from therapy. Adaptive equipment may be necessary if ROM, strength or sensation remains significantly impaired.
- Resolution of edema or independent with edema control home program.
- Resolution of pain or independent with home pain control program and/or referral to pain clinic.
- Maximize AROM of involved joints (see above regarding prognostication for individual AROM goals).
- Control hypertrophic scarring, and minimize scar adhesions that may limit active motion.
- Maximize potential for grip and pinch strength during ADL activities.

**Age Specific Considerations:** Elderly persons may take more time to heal. Younger people may heal more rapidly, but form scar adhesions sooner.

**Treatment Planning / Interventions:**

Established Pathway                      \_\_\_ Yes, see attached.                      \_\_\_x\_ No

Established Protocol                      \_\_\_X\_ Yes, see attached.                      \_\_\_ No

**Interventions most commonly used for this case type/diagnosis:**

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

- Orthotic fabrication
- Therapeutic exercise
- Patient/Family education
- Functional activities
- Physical agent modalities Wound care
- Scar management
- Neuromuscular electrical stimulation
- Biofeedback
- ADL retraining

**Modalities:**

Heat modalities may be initiated as needed once acute edema and wound issues are resolving, and there are no signs of infection. Immersion in fluidotherapy must wait until wounds/incisions are completely healed.

Research supporting ultrasound after tendon repair is limited, but suggests that low-dosed ultrasound may be appropriate in the early post-operative period to facilitate tendon healing. In the later stages of rehabilitation, the therapeutic heating effects of ultrasound may be utilized to enhance tendon gliding and decrease stiffness.

The use of neuromuscular electrical stimulation (NMES) to facilitate tendon gliding and overcome scar adhesions must wait until at least six weeks post-operative, until the tissues are ready to sustain a strong muscle contraction.

**Frequency & Duration:** Initial evaluation should be performed 1-5 days post-operative. Follow up 1-3x/weeks for approximately 12 weeks.

**Patient / family education:**

- Wound care
- Precautions (risk of infection, splint protection of repair, avoidance of active muscle contraction or passive stretching of repaired tendon)
- Exercise program
- Activities of daily living

**Recommendations and referrals to other providers:** Work hardening may be indicated pending work demands and level of injury. Work site assessment may be indicated. If the patient is unable to return to prior job, may benefit from Vocational Counseling.

## **Re-evaluation:**

### **Standard Time Frame:**

- Full re-evaluation every 4 weeks.
- Daily re-evaluation of specific problem areas addressed in each treatment session to verify treatment effectiveness.

### **Other Possible Triggers**

- New complaints of sensory changes
- Additional surgical intervention
- Significant change in pain or active motion

## **Discharge Planning:**

### **Commonly Expected outcomes at discharge:**

- Achievement of individual ROM and strength goals, taking surgical repair, patient health and healing, and work/ADL demands into consideration.
- Independent with home program.
- Use of involved upper extremity normally in most ADL and IADL activities, keeping in mind that most tendons are not ready for heavy resistance (> 10 pounds) until 10-12 weeks, and excessive resistance may rupture a tendon as late as three months post-operative.
- Independent with self care activities using minimal adaptive equipment.

**Transfer of Care:** Refer to CHT using [www.htcc.org](http://www.htcc.org) website if the patient is unable to return to therapy at BWH due to geographical constraints. See above section (Need for Skilled Services) regarding the importance of referring patients to specialized hand therapy centers.

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## REFERENCES

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