



Tendon Injuries of the Hand: Flexor Tendon

By James R. Roberts, MD

Part 1 in a Series

Emergency physicians are frequently called on to evaluate hand injuries that may harbor an injury to flexor tendons. The hand is anatomically complex and its function complicated, rendering this organ somewhat unforgiving of a missed diagnosis, incorrect initial treatment, delayed definitive therapy, and even splinting snafus.

Once deep hand structures are seriously injured, it may be difficult ever to regain full function, certainly not without significant time and energy on the part of a compliant and motivated patient and access to a physical therapist and hand surgeon. While EPs rarely perform definitive repair of complex hand injuries, we are on the forefront of diagnosis, and must have the acumen to diagnose obvious injuries, the perspicacity to intuit potential problems, and the wherewithal to limit morbidity and initiate proper referral.

In the long run, educated patients expect a hand surgeon to be involved in any complicated hand injury. Many indigent patients rely on the ED to provide most of their care. While all patients usually understand that a major hand injury will be a frustrating struggle to regain normal function, they rarely forgive any clinician's failure to at least do a complete exam, listen to them, anticipate potential problems, and

uncover real problems on the first visit. NPs and PAs in your fast track are also held to this standard. Hopefully these colleagues are also cognizant of the issues, perhaps even more so than most physicians who greatly respect hand injuries, and appreciate the nuances.

Leaving a foreign body in the hand or missing a tendon, nerve, or vascular injury is relatively easy when one is juggling patients with complicated cardiovascular, neurologic, traumatic, or respiratory emergencies. A quick glance, a cursory examination, or a truncated explanation to the patient about potential problems and the need for follow-up are common pitfalls for even a gray-haired professor. Each hand laceration should be approached with the notion that there is something wrong until proven otherwise. Physician hubris, inattention to detail, a hurried evaluation, or a less-than-ideal patient often lead to problems for doctor and patient.

The next few columns will discuss the diagnosis and treatment of flexor and extensor tendon injuries. Few clinicians would miss a completely lacerated extensor or flexor tendon, assuming that tendon function was adequately evaluated, but a major partial tendon injury, often initially clandestine in the depths of a swollen, bloody, and tender

laceration, can mislead even a hand surgeon on the first examination. This is especially true of flexor tendons. Even a significant extensor tendon injury can be missed unless attention is paid to the details of the examination. Fortunately, the emergency physician's job is usually infinitely easier than that of the hand surgeon who has to deal with delayed care, reconstruction, finicky tendons, patient compliance, and the rigors of hand rehabilitation.

A Flexor Tendon Injury to the Hand

Euhara D
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Not much has changed in the ED approach to hand injuries since I was an intern 40 years ago. It's still a bread-and-butter problem. This is an excerpt of a longer chapter on flexor tendon injuries that appeared in the *Emergency Medical Clinics of North America*. Other excellent reference articles include the *Orthopedic Clinics of North America* (1992;23[1]:129) and *Emergency Medical Clinics of North America: Orthopedic Injuries* (1999;17[4]:806). All major texts reiterate the party line contained in this article, but few address the practical matters and nuances of ED care that can only be learned through experience (or mistakes).

As with most issues in emergency medicine, an accurate history is the first step in understanding the extent of any injury. The author suggests allowing the patient to describe the mechanism of injury, including position of the hand at the time of the injury (closed, open, fist), and the time of injury. Listen to the patient's description of the object used to produce the injury, the possibility of foreign bodies, and whether the injury occurred in a clean or dirty environment. The patient should be allowed to voice subjective motor and sensory changes, a perceived decrease in strength, or any other problems with movement or sensation prior to the physician's examination. The authors emphasize that a great amount of data concerning possible tendon injuries can be obtained by a detailed history and knowledge of the mechanism of injury prior to actual examination.

Ask the patient if he thinks he has a serious hand injury, if the fingers work, and if there is a chance for a retained foreign body or broken bone. Prior to touching the hand, noting the posture of the hand in a resting position can be helpful to intuit flexor tendon injuries. The natural attitude of the hand is one of slight flexion of all joints, and if even a single finger does not assume the natural flexed position, some type of tendon injury is immediately suspect. The flexor digitorum profundus (FDP) and the flexor digitorum superficialis (FDS) tendon of each finger must be tested individually. If the distal phalanx cannot be flexed against resistance, an injury to the FDP is likely. If the PIP joint cannot be fully flexed against resistance, an injury to the FDS is suggested.

The prescient, sagacious, and likely previously mistaken clinician knows that partial flexor tendon injuries may simply be impossible to detect on the first examination. Clues to the presence of a partial tendon injury are subjective weakness voiced by the patient, pain upon flexion, or weakness when the digit is flexed against resistance. Otherwise, the fingers may seem to work just fine. Wounds should be anesthetized prior to complete examination. Obviously a complete neurologic evaluation is performed prior to local anesthesia. Get familiar with the term two-point discrimination. Good lighting, a bloodless field, adequate time, and good exposure of the wound are required for an ideal examination. A tourniquet can be used around the finger. For the hand, a BP cuff can be inflated above arterial



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The function of the flexor digitorum profundus tendon (left) and flexor digitorum superficialis tendon (right), the latter also called the flexor digitorum subimus, in each finger are tested separately by isolating the respective tendon's function. The specific procedure is documented on the chart. "Tendons intact" is a standard phrase used, but this is probably not sufficient to convince anyone that a sophisticated exam was performed. Better to document "individual FDP/FDS function normal." Naming the specific tendons tested certainly makes you look like a pro; you even know specific anatomical terms! To test the FDS tendon, place the dorsum of the hand on a flat surface, hold all fingers in extension except the one being tested, and ask the patient to flex the proximal interphalangeal joint. To test the FDP, check for fingertip flexion by immobilizing the rest of the finger. Also test flexion against resistance, looking for weakness. Although patients are always reluctant to move injured digits, weakness may be a sign of a partial tendon laceration.



pressure. This is painful, but can usually be tolerated for the time it takes for a proper examination.

The authors stress that the patient has to cooperate for the examination to proceed as planned. If the patient is uncooperative or otherwise unable to participate fully in the examination, a variety of options exist. The author of this paper suggests an examination under anesthesia, but this is often not practical or generally considered standard.

Comment: Flexor tendon injuries should not be taken lightly. Special attention is required to prevent long-term sequelae. Assuming that function is evaluated, few clinicians would miss a completely ruptured tendon. Unfortunately, many flexor tendon injuries are often quite subtle, and can fool even the most experienced EP. Entire books have been written about flexor tendon injuries, but I will address only the evaluation of flexor tendons secondary to penetrating trauma.

No clinician would disagree that mechanism of injury and a complete physical exam are paramount to proper medical care. I urge you to look at the last chart of a simple hand laceration that you treated to see if your charting was up to snuff. Assume that a previous patient had a partial tendon laceration, but a complete tendon rupture was noted on suture removal. Critically read the chart to see if your documentation demonstrated careful, conscious, and prudent evaluation and treatment in the ED, and one that would convince the patient that you made a good faith effort to evaluate fully his injury at 2 a.m.

The vast majority of clinicians give cursory attention to etiology. "Cut with knife" is a triage complaint, not a physician history. I almost never see the patients' own words quoted about their perception of sensation, function, or possibility of foreign body. Believe them: if they can't move it, especially after a pain pill or local anesthesia, it's likely true. If they think something is still in the wound, believe them. A huge chunk of glass can be a denizen of the palm with few outward clues. I try to document that "the patient does NOT think there is a foreign body or nerve injury." In my experience (usually with litigation), it's almost unheard of to encounter documentation of the specifics of such things as the attitude of the hand prior to evaluation or the results of testing against resistance. As a final check, see if that old chart documented response to light touch and two-point discrimination. Finally, evaluate your follow-up instructions and splinting and bandaging techniques.

To produce the best possible document, one should be crystal clear about charting etiquette. I find templated charts to be far superior to freeform handwritten

charts. Make an electronic macro that describes you best hand exam ever, and use it if appropriate. I urge the clinician to note carefully the positives and especially the negatives. The very inadequate "NVT intact" does little to convince anybody that a proper examination was performed if that is all that appears on the record. Although this discussion concentrates on flexor tendons, also consider the fact that tendon injuries often accompany nerve and vascular injuries.

History

The mechanism of injury is an important part of the ED record. Many patients will not be able to inform the doctor about all specifics. If a patient can't tell you whether the hand was flexed or opened, such information should be documented. At least you asked. It's very important to ask the patient and document on the record if he thinks he has a serious injury, if the hand or fingers all work OK, if he thinks there is a retained foreign body, or a broken bone. You would be surprised how many patients with missed foreign bodies of the hand or ruptured tendons testify that the doctor never asked questions, that they specifically told the doctor that they thought glass was in the wound, or there was numbness, or a finger did not work right. Two years later, they claim that the clinician ignored their specific complaint or simply failed to look. Unless pertinent negatives are charted, it's difficult to counter patient accusations that the evaluation was hurried or lax.

Foreign bodies are notorious for their clandestine presence. I always chart that "no foreign body was suspected by the patient," and that none was seen by me. At least I asked and looked. Our computerized discharge instructions caution patients that not all foreign bodies or other injuries can be diagnosed on the first visit, but there is little solace in that boilerplate disclaimer.

Radiography

Obviously, radiographs are used when there is a possibility of bony injury, but



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Testing two-point discrimination is an excellent way to assess digital nerve integrity. Simply because of the location of this laceration, a digital nerve injury should be immediately suspected. To make sure the patient understands the nerve testing concept, use an uninjured finger as a control, with the patient closing his eyes. A straightened paper clip is a readily available testing device. Perform the test with a single point and with two points, about 4-5 mm apart. If the patient can consistently distinguish the two points of a paper clip distal to the laceration, the digital nerve is unscathed. Do not place the two prongs on the distal finger fat pad, but rather along the side to isolate only one digital nerve, and avoid crossover sensations from the opposite digital nerve. The paper clip can also be gently stroked over the skin to test light touch. The chart should reflect "light touch/2 PD intact."

more subtle findings can be uncovered by an x-ray. Almost all glass is visible on plain x-rays, even very small pieces. At least two projections should be taken to remove the possibility of overlying bone obscuring a small fragment of glass. For the patient who fell on an outstretched hand in a field, stuck his hand in the garbage can, or punched out a window, an x-ray is mandatory unless the laceration is obviously superficial. Plain radiographs have a high sensitivity for detecting most foreign bodies. (*Ann Emerg Med* 1996;28[1]:7.)

Most gravel, pencil, graphite, and other foreign bodies that should not be left in the hand are visible by radiograph, but wood and aluminum can be occult. For those who naively believe that they can accurately suspect a foreign body by history or can find foreign bodies in wounds by a careful examination, you are not that smart. I urge the hubris-laden clinician to read an article by Steele et al. (*Am J Emerg Med* 1998;16[7]:627.) In that prospective study, retained glass was found by x-ray in 16 of 146 wounds that were deemed free of foreign bodies by the patient's history and patient perception! Eight foreign bodies were seen on x-ray in 165 wounds when the physician's wound exploration was negative. Puncture wounds should always be most suspect.

Knife blades can break off in hands, and extremely large and nasty foreign bodies can be embedded deep in a hand wound, which may initially fool patient and clinician. I don't know whether it always helps, but maybe the conversation and chart should read: "I don't see/suspect a foreign body or tendon

injury now, but I informed the patient that they are not always diagnosed on the first visit, so we have scheduled a recheck in three days." Document the actual date of follow-up and the time, place, and consultant's name and number to be overly paranoid, if not pristine. Document that you did not give any 100 percent guarantees.

Testing Functional Status

Examine each finger individually, with specific testing for the profundus and superficialis tendons. Let the chart know you are familiar with the specific tendon names, a nice erudite touch. Many patients who have painful injuries are reluctant to move digits, but usually some motion can be detected. Motion limited by pain can indicate a normal tendon or one that is 90 percent lacerated. Never conclude that a patient who says his finger won't work is in too much pain, too drunk, or just being uncooperative to move it.

If a finger doesn't move, regardless of the apparent severity of the injury or an assessment of the cooperation of the patient, one should assume a complete tendon laceration. With a little bit of coaxing, even a very painful injury can demonstrate some movement. Even if a tendon is 80 percent lacerated, however, it will provide some function, and many will appear surprisingly normal. If tested against resistance, however, weakness may be apparent. Certainly it is not out of the question and probably prudent to administer analgesics or local anesthesia if the patient is in so much pain that you cannot even begin to examine flexor tendon function.

Partial Injuries

In most cases, a partially lacerated flexor tendon will escape detection unless the tendon injury can be fully visualized or the clinician maintains a high degree of suspicion. Succinctly stated, it is simply impossible to diagnose all partial flexor tendon injuries accurately on the initial ED visit. The most common clinical error is to assume that full range of motion guarantees an unscathed tendon. Partial injuries often progress to complete rupture at follow-up or suture removal, or with the first forceful grip, often complicating repair or delaying definitive intervention.

Some subtle clues may suggest the presence of a partial tendon laceration. The first clue is the patient's own description of hand and finger activity. Listen carefully to the patient. The next red flag is weak flexion against resistance. If you don't test a tendon against resistance, you will not appreciate this subtle abnormality. Merely asking the patient to flex the finger while you watch doesn't always equate to a complete evaluation. A completely intact

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FLEXOR TENDON

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flexor tendon is strong, and should not give way with an opposite force. If the patient says he can move his finger but it feels weak, assume a partial flexor tendon injury.

One frantic ED visit may not be enough for total care. Because no mere mortal can always detect a 50-90 percent laceration of a deep flexor tendon, proper initial wound care, splinting, and timely follow-up are the patient's and EP's best friends. Let someone else make another assessment a few days later when the anxiety, rage, alcohol, and swelling have dissipated.

Another suspicious finding is pain at the area of the wound when flexion is performed. Cut edges of tendons may irritate delicate tissues and don't always glide well in the tendon sheath, so pain with active flexion or passive extension may be subtle signs of a partial tendon injury. Also, a partial tendon laceration may result in an abnormal resting posture of the hand. Somehow the body just seems to know that a partially lacerated tendon should be rested and not stressed. Finally, neurologic or vascular deficits are guilt by association, and such findings may signal an injury deep or extensive enough to raise suspicion of collateral tendon damage.

Wound Exploration

It is usually quite simple to extend a laceration of the dorsum of the hand or fingers, and simply view the superficial extensor tendons throughout full range of motion. Flexor tendons are deep structures of the hand, however, and are not readily visible to the clinician's eye. I could find no great insight in the medical literature concerning ED evaluation of puncture wounds of the hand, especially about extending the laceration and attempting to visualize deep flexor tendons. I would advise against extensive attempts at visualizing flexor tendons of the hand if it requires deep dissection or other aggressive wound manipulation. One simply has to realize that the emergency department is not the place to muck around in deep palmar spaces. If the wound is open, good local anesthesia and a BP cuff tourniquet can allow for good inspection and adequate wound cleaning.

I hate palm puncture wounds; most cannot be cleaned to normal wound care standards. Some are done with cooking utensils that carry bagel parts, clam juice, or meat. One can slightly extend the superficial margins of a puncture wound, but do not place an irrigation catheter deep in a puncture wound and expect forced irrigation to help. Often all that does is disseminate debris or swell up the palm. All

puncture wounds of the palm should be viewed as potential problems, with the understanding that you may not be able to evaluate fully the extent of the damage on the first ED visit. The prudent clinician will tell every patient with a puncture wound of the palm that there may be a partial tendon laceration that requires further evaluation when the pain and swelling have subsided. If you are wrong, so what?

Consultation and Referral

Most articles written by hand and orthopedic surgeons naively state that emergency physicians should immediately refer all questionable flexor tendon problems to a hand surgeon. This sound good on paper, but I have yet to meet a hand surgeon who will immediately come to the ED to comply with their own mandate. Certainly a hand surgeon cannot sober up an intoxicated patient nor wake up an unconscious one. Uncooperative patients will not move the hand for a guy in an Armani suit any better than for a harried ED doc in scrubs.

I usually get the instructions to clean, close, and splint the injury, give antibiotics, and send them to the office. Try to get an expeditious hand surgeon office visit for a patient who grabbed an equally drunk opponent's knife in a bar fight three days ago. My hospital does not even have a hand surgeon on staff! And orthopedic surgeons in Philadelphia have largely abandoned all hand surgery. Today, many hand surgeons simply will not take ED call. I don't blame them. Who wants to take care of a litigious uninsured patient who will not keep on the splint, blows off a \$4 Walmart prescription for Keflex, fails to show up in the office for free care as planned, and will not even consider physical therapy.

Little will be accomplished by a mandated hand surgeon evaluation in the ED. An EP can ask the patient to flex the hand as well as a specialist, and there is no need for a hand surgeon to repeat the equivocal or abnormal examination that has been done in the ED. Maybe the hand fellow will be available, but there is no need for a busy surgeon to be there in an hour to repeat your examination. Local customs vary, but most surgeons will not routinely take patients from the ED to the OR merely to explore a laceration. This is especially true if the wound is old, contused, swollen, or dirty. Tendon injuries are rarely an emergency; it's all about the ED care and follow-up.

Most specialists prefer to delay definitive care of even known flexor tendon lacerations for a few days until swelling, infection, and bleeding can be controlled or abated. Partial tendon lacerations usually do well with identification and splinting only. My approach to a questionable flexor tendon injury in the ED, or even the obvious complete flexor

tendon injury, is first a phone consultation with an appropriate specialist. Of course, carefully documenting his advice and follow-up requirements is a given. I always give the consultants the option of performing their own examination, but they rarely take me up on it.

When they do and come to the same conclusion, the course of action is usually the same as it would have been over the phone. Don't attempt to handle equivocal cases on your own. Always make the phone call. Relay your findings and concerns, and fully document the interaction. The best reason to persuade the hand surgeon to come to your ED is to teach you the finer points of the hand examination and to quiz them about follow-up options. If you see the rare hand surgeon in the ED, don't let him get away without picking his brain to the point of being annoying.

Follow-up

No special follow-up is required for the finger injury where flexor tendons can be visualized throughout the full range of motion and a partial tendon injury can be absolutely excluded. Standard wound preparation, suturing, and dressings are usually appropriate. For the patient with a deep puncture wound of the hand and for those with suspicious, equivocal, or abnormal examinations, it is best to treat the injury as a potential partial tendon laceration that will rupture in a few days.

No data support the routine use of prophylactic antibiotics for penetrating trauma producing deep punctures or lacerations of the hand, but many clinicians will prescribe three to five days of an antistaphylococcal antibiotic. This is not usually a MRSA issue. Inoculation of flexor tendon sheaths can produce nasty infections, so I suppose it's reasonable. There is no standard that mandates

Suggested Electronic Record Macro for Hand Examination

Default History:

- *Detailed history includes _____.
- *Position at time of injury _____.
- *Occurred _____ hrs prior to admission.
- *Environment of injury _____.
- *Care prior to ED visit _____.
- *Pt. denies sensation/concern for fracture, foreign body, excessive debris, numbness/tingling of fingers, weakness of fingers, or difficulty moving any joint.
- *Prior hand/finger problems _____.


Default Exam:

- *Hand/wrist/fingers held in normal resting position.
- *Flexor tendons: Full active/passive ROM, and normal flexion of all superficialis/profundus tendons against resistance.
- *Extensor tendons: Full active/passive ROM, and normal extension of all fingers against resistance.
- *No FB seen on exam consisting of _____.
- *Normal light touch/sharp/two-point discrimination of all fingers.
- *Tendon visualization _____.

Attention to detail: Most EPs do not document their history or exam anywhere close to this detail, and this is not intended to define standard of care. It is an attempt to strive for your best chart ever, peppered with paranoia and an attempt at excellence in charting that can, in the course of normal ED stresses, be a laudable albeit uncommon-to-achieve goal. Although not currently standard of care, the templated electronic medical record prompts the busy clinician to document details of the history and exam to an extent not usually performed in standard practice. The macro document can be modified to fit individual style, but includes the majority of information required to memorialize your most perfect examination.

routine antibiotics for any soft tissue lacerations, except perhaps under the standard circumstances of immunocompromise or obvious infection. Obviously, antibiotics are not a substitute for proper wound irrigation, removal of foreign bodies, or immobilization.

My general rule is to splint it when in doubt. Few puncture wounds or lacerations of the palm leave my care without some sort of splinting designed to protect tendons and limit pain and movement.

Next month's column will discuss the uncooperative patient and definitive ED care. 



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