An Ongoing Series

Hand Injuries

Joshua Banting[1]; Tony Meriano, MD[2]

CONCEPTS AND OBJECTIVES

The series objective is to review various clinical conditions/presentations, including the latest evidence on management, and to dispel common myths. In the process, core knowledge and management principles are enhanced. A clinical case will be presented. Cases will be drawn from real life but phrased in a context that is applicable to the Special Operations Forces (SOF) or Tactical Emergency Medical Support (TEMS) environment. Details will be presented in such a way that the reader can follow along and identify how they would manage the case clinically depending on their experience and environment situation. Commentary will be provided by currently serving military medical technicians. The medics and author will draw on their SOF experience to communicate relevant clinical concepts pertinent to different operational environments including SOF and TEMS. Commentary and input from active Special Operations medical technicians will be part of the feature.

The Cases

You are deployed overseas on a multinational joint training exercise. You are providing medical coverage for a group of approximately 250 military personnel. While conducting sick parade, a couple of patients come see you with injuries to their hands.

The first patient is 24-year-old supply technician who was opening some crates with his knife and accidentally cut his left hand. The cut looks deep and is across the palmar surface of the fingers and has cut the middle and ring fingers. The second patient has a laceration to his right hand involving the dorsal surface over the index and middle fingers at the metacarpophalangeal joint.

Before you delve into the cases you spend a couple of minutes reviewing the approach to hand injuries with your junior medical technician. The hand is an incredibly complex structure. An intricate network of nerves, tendons, and muscles work together to allow us to perform complicated and fine movements. Many of the key structures lie very superficially and are subject to injury. When taking the patient's history, there are key features to document with all hand injuries. Many of these questions revolve around understanding the potential functional outcomes of the injury and the risk of infection. Infections in the closed spaces of the hand can be particularly devastating.

Assessment of Hand Injuries

Mechanism

The exact mechanism that caused the trauma is important to document because it allows the clinician to understand what underlying structures may have been injured. In addition, it is important to understand what position the hand was in during the injury. This is critical because tendons may be in a different position during the examination, and visualization of an injury may not be possible. In addition, understanding the mechanism helps the clinician assess the risk of infection from the injury.

Time of Injury

Knowing the time of the injury is important because it can be a factor in determining the treatment. For instance, depending on assessment of the risk of infection, a clinician may delay closure of a laceration that is more than 18 hours old.[1]

Hand Dominance

It is important to document which is the dominant hand of the patient, because this will help the clinician assess the impact of the injury on the patient's functional ability.

Work and Hobby History

Understanding how the patient makes their living is important because this will allow the clinician to understand the potential impact of the injury on the patient's career. For instance, injury to a precision shooter's dominant trigger finger may be far more important than an injury to their little finger.

Prior Injuries to the Hand

Documenting prior injuries, including neurological or functional injuries, is important because this allows the clinician to understand the baseline function of the patient's extremity.

Comments and suggestions can be sent to sofclinicalcorner@gmail.com
[1]**LT Banting CD, BSc, CCPA,** is a physician assistant with CANSOFCOM. [2]**Major Meriano** is a practicing emergency physician who has served in various capacities with the Canadian Forces and Reserves since 2003.

Tetanus and Immune System Status

Part of good wound management is understanding the patient's tetanus status and risk, and their immune system status. Certain medical conditions could affect the patient's ability to fight off infection. Patients with diabetes and tobacco use are particularly at risk for delayed healing and infection.[1]

Examination

Examination of the hand should be conducted systematically after gaining a clear understanding of the mechanism of injury. It is important to have know the underlying anatomy of the hand and wrist. A good hand examination includes assessment of neurological sensation and function, tendon examination, vascular assessment, range of motion, and palpation.

A full anatomical review is beyond the scope of this article, but we will review a few key features, especially as applied to the fingers.

Nomenclature

When describing injuries to the hand it is important to use concise and reliable terms that your colleagues can understand. This is critical for the tactical clinician because you may have to describe the injury to a higher medical authority without the benefit of time or good clear communications. Generally, the back of the hand is the dorsum (or the dorsal aspect) and the palm side is referred to as palmar (or volar). The terms medial and lateral can be indistinct, so the terms radial (thumb side) or ulnar (little-finger side) are used for localization. There are many naming systems for the fingers, but it is most accurate and simple to name them as thumb, index, middle, ring, and little finger.

Neurological

The hand is innervated by the radial, ulnar, and median nerves (Figure 1). These branch at the wrist and provide sensory and motor function to the hand. These nerves further divide to innervate each finger via the digital nerves. These digital nerves run up the finger in a neurovascular bundle on both the radial and ulnar aspects of each finger.

Figure 1 *Innervation of the hand.*

Sensory examination of the radial, ulnar, and median nerves can be conducted by assessing sensitivity to sharp in key locations (Table 1). The motor function of these nerves also should be assessed.

If there is a potential for digital nerve injury, the sensation should be conducted by determining two-point discrimination on the radial and ulnar side of each palmar fingertip. This can be done by using a paper clip with the prongs bent apart. Typically, a patient should be able to determine the presence of two points 5–6mm apart (Figure 2).

Table 1 *Neurological Examinations of the Fingers*

Nerve	Sensory Examination	Motor Examination
Radial	Dorsal thumb–index finger web space	Thumb extension
Ulnar	Palmar tip of the little finger	Resisted abduction of the fingers
Median	Palmar surface of index finger	Resisted thumb palmar abduction

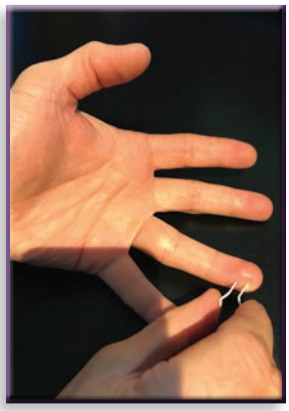

Figure 2 *Two-point discrimination.*

Bony Structures and Soft Tissue

Bones of the Hand

Moving distally from the wrist, the carpometacarpal joints are formed between the carpels and metacarpals. The metacarpals then extend the length of the palm and meet the phalanges at the metacarpophalangeal joints. Each individual digit is composed of three segments of phalange, with the thumb being the exception as it is composed of only two phalange segments. Intersections of the phalanges form the proximal interphalangeal and distal interphalangeal joints, respectively. When performing an assessment, taking note of the general appearance of the hand and noting any discoloration, edema, deformities, or pain may indicate injury to the underlying bone structure. This is especially true of the surrounding joints, as dislocations or fractures in these areas are prone to complications if undiagnosed. What initially appears as a simple laceration may be in fact an occult open fracture. Plain radiographs are generally preferred, especially if there is a possibility of a retained foreign body, such as an injury from broken glass. Given operational limitations, ultrasound may be an alternative to help diagnose a fracture; however, this tool is user dependent and requires practice.[2]

Tendons

The thumb has a more complex anatomy and tendon function than the other fingers, and injuries to it can have a major impact on the function of the hand. Injuries to the thumb cannot be fully discussed within the confines of this article, but generally injuries specific to the thumb or the surrounding connective tissues should have primary wound care and splinting, followed by referral to a hand specialist. The remaining fingers each have three tendons; an extensor tendon on the dorsum and two flexor tendons on the palmar side.

The extensor tendon arises from the extensor muscles in the forearm and branches at the wrist to provide extension to each of the fingers. It is not a simple band; it has a series of central and lateral components that allow portions of the finger to be extended. The extensor tendon lies anatomically quite superficially. Injury to this tendon can result in a lack of extension.

This can be known as extension lag and one finger may appear not to fully extend. To assess this tendon, the affected finger should be extended (Figure 3). If no lag is noted, then the resistance should be applied to the finger to determine strength against resistance and assess if pain occurs.

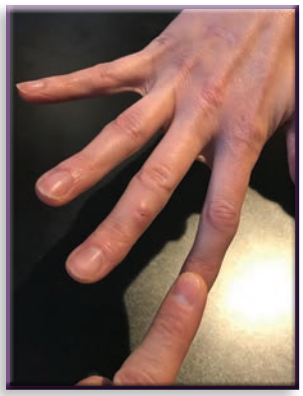

Figure 3 *Extensor tendon examination against resistance.*

If there is pain at the laceration site or along the tendon during resistance, then the clinician should suspect an underlying partial tendon injury is present.[2]

The two flexor tendons that supply the index, middle, ring, and little fingers are the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP). The FDS lies superficial to the FDP and ends just distal to the proximal interphalangeal joint (PIP). When contracted, the FDS flexes the finger at the PIP joint. The FDP inserts at the palmar surface of the distal phalanx just past the distal interphalangeal joint (DIP). It flexes the DIP joint.

To assess the FDS, the other fingers are held in extension and the patient is asked to flex the finger at the PIP. It should be tested against resistance (Figure 4). To assess the FDP, the DIP joint should be held in extension and the DIP flexed against resistance (Figure 5).

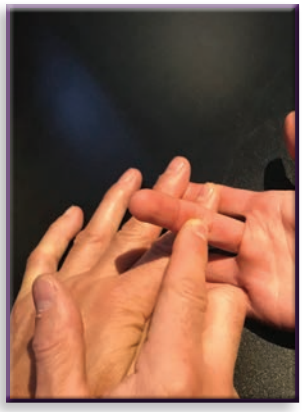

Figure 4 *Examination of the FDS tendon.*

The other fingers are held in extension while the finger being tested is flexed at the PIP joint against resistance. The finger being tested is immobilized at the PIP joint; the DIP joint is then flexed against resistance.

Vascular status of the fingers can be assessed by capillary refill. The blanching should resolve in under 2–3 seconds.

If a tendon injury is suspected, it is good clinical practice to try to visualize the tendon. This obviously depends on the clinical

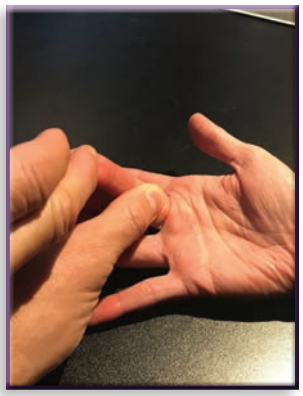

Figure 5 *Examination of the FDP tendon.*

scenario. To accomplish this after carefully documenting neurovascular status and function, the wound can be cleaned and anesthetized. A blood pressure (BP) cuff or tourniquet can be used to temporarily create a bloodless field and the wound can be irrigated with sterile fluid. Careful inspection of the wound may allow the clinician to visualize a partial tendon injury or may reassure you that no deeper structures are injured. It is critical that the wound be inspected with the finger in the position that it was during the injury, because the actual tendon laceration may be retracted proximal to the wound during the examination. If a partial tendon laceration is visualized, noting the depth and approximate degree (percentage) of tendon injury may determine if the tendon should be primarily repaired.

Case Presentations

After this review, you examine your patients.

Patient 1

Patient 1 is a 24-year-old supply technician who cut the palmar aspect of his left-hand middle and ring fingers with a knife while opening boxes. The laceration is across the palmar aspect of proximal phalanx of the middle and ring finger and extends ulnarly. It occurred with a clean knife about 3 hours ago. He is right handed. The patient's tetanus status is up to date and he has no comorbid illness or allergies. He does not smoke cigarettes (Figure 6).

Figure 6 *Patient 1's injury.*

On examination, he has good capillary refill to all affected fingers. His sensory examination demonstrated normal two-point discrimination to the radial and ulnar aspects of the middle finger and decreased sensation to the ulnar aspect of the ring finger. He has full flexion of FDS and FDP but has significant pain with resisted FDS examination of the ring finger.

Your anatomical knowledge leads you to suspect a digital nerve injury and partial laceration to the FDP tendon at the ring finger. You anesthetize the wound with a metacarpal block and irrigate the wound with normal saline. After applying a BP cuff as a tourniquet, you carefully inspect the wound and are able to visualize a deep laceration to the ring finger, which appears to have injured the tendon.

You consult with a higher medical authority. They recommend you close the wound with interrupted sutures and splint the affected fingers. The splint should prevent further injury to the fingers and be flexion blocking, so that the existing tear in the tendon is not increased by forced flexion. The plan is to electively evacuate the patient to a hand surgeon for possible flexor tendon repair and consideration for primary digital nerve repair. No antibiotics are indicated.

Patient 2

Patient 2 is a 22-year-old partner-nation special operator. He has a laceration to his dominant hand (right) over the extensor surfaces of the middle-finger metacarpal phalangeal joint (Figure 7). The laceration is jagged. He reports the injury occurred after he tripped and fell on loose ground. He reports it occurred approximately 12 hours ago. He is not diabetic and his tetanus status is current. He does smoke cigarettes. He inquires if you are going to inform his chain of command about his injury.

Figure 7 *Patient 2's injury.*

Examination demonstrates normal capillary refill and normal two-point discrimination. He has full resisted tendon function of FDS, FDP, and extension. There is some pain with resisted extension. You also notice that that this patient has some facial contusions.

You suspect a fight bite, which is a term that describes an injury sustained to the knuckles (dorsal MCP) when striking someone in the mouth. During impact, the teeth can lacerate the knuckle over the MCP. This can lacerate the extensor tendon and penetrate the MCP joint. The teeth carry significant amounts of bacteria. These bacteria can grow in this joint, cause a septic joint, and lead to destruction of the joint. It is critical that the wound be carefully inspected to determine if the joint is penetrated. If so, it requires a surgical washout. Early antibiotic administration is critical. Many patients may not reliably report the mechanism out of fear of disciplinary repercussions. A high index of suspicion must be held for any injuries that fit this pattern.

After further discussion, the patient says he obtained the laceration during an altercation. You initiate the antibiotic combination of amoxicillin and clavulanate, irrigate the wound, and splint the hand in the position of function. The patient is referred to a higher level of care for a more thorough wound inspection and irrigation of the injury.

Summary

The hand's function is a complex interaction of an intricate series of nerves, muscles, and tendons. These structures are very superficial and thus prone to injury. A good understanding of the anatomy and a careful history and systematic physical examination are essential to detect and treat potential injuries with the goal of preserving function.

Disclaimers

The views and medical opinion herein represent those of the authors. They do not reflect the operation practice or views of the Canadian Forces or other organizations. The cases are provided to be educational and thought provoking; at no time does the author suggest that the tactical clinicians exceed the scope of their practice or act against the direction of their medical protocols or recommendations of their medical leadership.

Disclosure

The authors have nothing to disclose.

Author Contributions

Both authors contributed equally to the manuscript and had final approval.

References

1. **Hollander JE, Singer AJ.** Laceration management. *Ann Emerg Med*. 1999;34(3):356–367.
2. **Hart G, Uehara DT, Wagner MJ.** *Emergency and Primary Care of the Hand*. Dallas, TX: American College of Emergency Physicians; 2001.

The Special Operations Medical Association's Official Journal

JSOM

JOURNAL *of* SPECIAL OPERATIONS MEDICINE™

Winter 2017
Volume 17, Edition 4

THE JOURNAL FOR OPERATIONAL MEDICINE AND TACTICAL CASUALTY CARE

Inside this Issue:

Dedicated to the Indomitable Spirit and Sacrifices of the SOF Medic

A Peer-Reviewed Journal That Brings Together the Global Interests of Special Operations' First Responders