

# **Hand Injuries**

## **SRPC Rural Critical Care Module**

**C. Stuart Johnston, M.B., Ch. B., M.Sc.(Civil Eng), C.C.F.P., FRRMS**  
**Associate Clinical Professor UBC**

### **THE MANGLED HAND**

#### **Introduction**

Mangling injuries of the hand are defined as serious injuries involving multiple vital structures that often lead to significant physical and psychological disabilities later on.

Multiple systems, including bones, muscles, tendons, vessels, nerves and skin, may be involved, and it has been found that the resulting scar formation extends from the skin down to the deepest damaged structures. This impacts significantly on the function and blood supply during and after the recovery process. (For example, the permanent sensitivity to the cold of a previously injured finger.)

To minimise this scar formation it is imperative that the tissues are handled with care, cleaned well and the blood supply restored as soon as possible. Non-viable tissue should be removed, fractures stabilised and coverage of the exposed tissues attempted.

#### **Some basic principles when dealing with serious hand injuries**

1. Preserve life.  
Treat the patient, not just the hand. There are often other life threatening injuries present which must be dealt with first – ATLS approach with attention to the ABCs.
2. Preserve tissues.  
Be conservative, particularly in young patients, preserve viable tissue whenever possible. You can always take tissue away later, to replace tissue is much more difficult. Handle all tissues gently.
3. Preserve function.  
Try to maintain digit length, particularly the pincer grip function. Give realistic reassurances regarding recovery.
4. Be aware of the ‘Zone of injury’. This concept recognizes that the area of injury often extends well beyond the area of initial injury. For this reason it may be necessary to delay closure of large wounds until re-examinations of the wound at 24 to 48hrs post injury do not show any further tissue ischemia and necrosis.
5. Try not to hurt or frighten the patient. Once the sensation has been assessed and documented provide anesthesia before further examination of the injury.
6. Confer with specialist colleagues early if in doubt. The Dept. of Plastic Surgery at your nearest major hospital will usually be very helpful if your usual consultant is unavailable.

## **Dealing with the Mangled Hand as a GP surgeon**

Much of the management is no different than any other trauma case. However the following may be useful when dealing with hands.

### **Initial evaluation**

ATLS approach and ABC's. Hemostasis becomes the priority if major bleeding is occurring. Look for other injuries associated with a significant injury force.

### **History**

*When* did the injury occur? This is important because of ischemic tissue time.

As a rule of thumb, bone may survive more than 6hrs without a blood supply, muscle about 4 to 6hrs and nerves 2 to 4hrs. This is temperature dependent, and the muscle can be revascularised up to 24hrs later if cooled. A finger has been successfully reattached after 94hrs with cooling.

*Where?* Was it in a farming environment (usually highly contaminated and need extensive debridement), or an industrial setting with oils or caustic substances contaminating the wound?

*Where* does the patient come from? This impacts on the post-operative care plan.

*How?* What was the mechanism of the injury? How much force was involved? Was it a sharp or a crushing type injury? High velocity, high-pressure, crushing or avulsion injuries have a much larger 'Zone of injury' and require more extensive debridement, assessment of surrounding tissues and awareness of compartment syndrome.

### **Examination**

After dealing with any life threatening injuries attention is turned to the hand.

It may be easier to do this in an OR setting if the injury is substantial and wrapped in blood-soaked bandages. Usually an assessment of the vascular status, sensation, muscle and tendon function and X-Rays can be done in the ER.

Vascular status is the primary concern. Traditionally nail bed capillary refill time is used, however this has been shown to be a very unreliable indicator of perfusion because blood simply moves laterally with compression of the nail, and returns to the center on release. A more accurate area is the dorsal paronychia tissue on the sides of the nail, which should be pink and spongy, with good turgor, compressing with pressure and refilling with release within about 4 seconds. A dusky color with exceptionally brisk refill can represent venous congestion.

Have a high index of suspicion for compartment syndrome.

Skeletal injury is best determined by X-Rays after the initial assessment. It is unnecessary (and traumatic for the patient) to manipulate the limb to determine whether a fracture is present. Remember to take AP and Lateral views if possible to avoid missing hidden fractures or significant displacement.

Muscle-tendon injury can be assessed by asking the patient to flex and extend the fingers and wrist. This may be difficult in the presence of pain. Additionally one can observe the movement (cascade) of all the fingers as the wrist is passively flexed and extended in the comatose or anesthetized patient. A relative weakness on testing flexion or extension of a digit, or a lag on full extension often indicates a partially transected tendon, or a completely lacerated extensor tendon with some extension function remaining from the 'cross-over' extensor bands (Juncturae tendinum) on the dorsum of the hand.

Nerve injury requires assessment of both the motor and sensory function.

**The motor function of the Median, Radial and Ulnar nerves** is checked by testing both extrinsic and intrinsic muscle function. Three simple maneuvers test motor integrity: (1) resistance against palmar abduction of the thumb reflects the median nerve-innervated abductor pollicis brevis function; (2) resistance against flexion of the MCP joint of the little finger reflects the ulnar nerve-innervated flexor digiti quinti function; (3) resistance to extension of the MCP joint of the index reflects the radial nerve-innervated extensor digitorum communis and extensor indicis proprius.

**The sensory nerve function** can be assessed by checking both sides of each finger if damage to the digital nerves is suspected, or more generally, the volar aspects of the index and middle fingers for the median nerve, the volar aspect of the little finger for ulnar supply and the dorsum of the first web space for Radial nerve supply.

With sharp or penetrating injuries if you "think the nerve is probably OK", it usually is not, and warrants exploration. Blunt trauma on the other hand may lead to neuropraxia with an intact nerve.

## **Treatment**

### ***Antibiotic cover***

The early administration of antibiotics is critical to their efficacy. Generally a first-generation cephalosporin is adequate (the most common organism is Staph' aureus), with the addition of an aminoglycoside for farming or highly contaminated wounds.

Tetanus prophylaxis

### ***Blood supply***

Avascular limb – attempt to straighten the injured part to re-establish blood flow, or urgently refer to a hospital where revascularization can be attempted if blood flow cannot be re-established or the vessels have been severed ('tag' the ends of identified arteries). Tissues may still be viable after up to 3 hours of ischemia depending on the ambient temperatures. This can be extended to about 7 hours if the affected limb is chilled on a bed of ice (with protection from frostbite) during transfer.

Compartment syndrome – this is a surgical emergency requiring decompression ASAP.

Hemostasis – use pressure or ligation of vessels under direct vision. Avoid using hemostat clamps blindly as this may lead to nerve damage. To improve visualization of a bleeding vessel use a running drip tube (opened fully) with N saline to provide continuous irrigation of the area.

### ***Bone #***

Attempt to gently reduce fractures, and stabilize definitively (e.g. K-wires or a cast), or support the limb in a temporary splint until specialist care is available.

### ***Nerves***

Assess nerve damage, record the findings, and then anesthetize as required.

If severed nerves are identified whilst debriding the wound, the ends should be 'tagged'.

### ***Debridement***

"The initial debridement is perhaps the single most important step that determines the functional outcome of mangling injuries." (Green's Operative Hand Surgery)

There is good evidence that removing devitalized tissue early results in better outcomes.

Meticulous cleaning of all foreign material from the wound must be done.

With a mangling-type injury this is best done in the OR.

Use mayonnaise or butter to emulsify petroleum products and tar on the skin.

Gentle handling of the tissues with copious N saline irrigation minimizes further tissue trauma.

### ***Skin***

Preserve skin bridges whenever possible.

Keep recovered skin in N saline gauze in a bag stored on ice for possible future use.

### ***Amputation***

In general if amputation is necessary it is best done at the time of the initial repair.

That being said, the GP Surgeon needs to bear in mind a number of things:

The thumb generally comprises 40% of hand function and the index and middle finger 20%.

All traumatically amputated tissue including digits or limbs should be stored as per the transportation guidelines in the event that it may be reused/reattached at a later time.

The decision to amputate or not may be tempered by such things as the patient's age, health status, smoking history and previous finger function.

Remember that most open fingertip injuries without exposed bone will heal secondarily.

Remember that there are ways of preserving finger length that can be safely done by the GP Surgeon, for example the V-Y Flap, the Wolfian graft, skin grafting using recovered tissues.

Be aware that there are techniques that the specialist surgeons can use to preserve degloved limbs and digits.

Reattachment of a digit below the level of the DIP is virtually impossible because of the diameter of the digital vessels.

### ***Tendons***

Primary repair of **extensor tendons** may be done after careful debridement. A simple figure 8 braided non-absorbable suture is ideal, but a nylon 6/0 will also work well. It is important that the ends of the tendon are healthy and have not been severely crushed and traumatized. If there is doubt then 'tag' the ends of the tendons using nylon 6/0 and close the skin if possible. This facilitates later repair. Early repair helps restore function more quickly.

**Flexor tendon** repair depends on the experience of the GP Surgeon and the extent of other injuries.

### **TRANSPORTATION OF HAND INJURIES**

- Seek specialist advice early if a referral out looks likely.
- Analgesia
- Do not do local blocks until the sensation has been assessed.
- Provide good analgesia for any transfer as the movement will cause pain.
- Elevate the affected part above heart level.
- Gently stabilize fractures to minimize movement en route.
- Protect open wounds with saline soaked gauze (ABD pads also work well).
- I then wrap the whole hand in a plastic sheet (a clean 'blue pad' is the simplest).
- Keep the parts. Store avulsed skin or amputated digits in normal saline-soaked gauze inside a plastic bag which is placed in another plastic bag containing ice and water.
- Record your findings and assessment in the referral letter. Include any blocks
- Chill ischemic tissues whilst waiting for re-establishment of a blood supply.

### **EXTENSOR TENDON REPAIR.**

Repair of extensor tendons by rural physicians is considered to be an acceptable procedure to do, with adequate care and training. The post-operative care and follow up is important.

There are some basic concepts to follow in repairing tendons, which if observed should reduce complications, and give good outcomes.

- Treat the patient – not just the hand!
- Be conservative in dealing with tissue. Preserve viable tissue.
- Determine sensory status before anaesthetizing.
- Handle all Tissues gently. Don't clamp bleeders 'blindly'.
- Keep the tissues well hydrated with normal saline.
- Use a 4/0 Ticron suture (or any non-absorbable 4/0 or 5/0 material) for the tendon repair, and a 6/0 nylon suture for the epitenon repair if needed. (The epitenon repair is usually unnecessary.)

- Use a modified Kessler suture if possible, but even a simple ‘figure 8’ works well.
- Call your nearest Plastic or Orthopedic surgeon for advice if you have any concerns about the best way to proceed.
- If you are uncomfortable attempting the repair, close the skin or cover the wound ( after careful cleaning ) and ship the patient.
- Tagging the tendons with a suture prior to transfer to a specialist will facilitate subsequent repair
- Follow up at least weekly in the initial recovery phase.
- Protect the repair from tension with a splint for the first 3 weeks.
- Initiate physiotherapy early, and follow up to ensure good ROM.
- I routinely cover tendon repairs with an antibiotic if I suspect contamination may have occurred at the time of the injury. (Usually Keflex 500mg TID x 10 days).

### **NAILBED INJURIES**

- Provide a digital block to allow adequate cleaning and assessment.
- Remove the nail if a significant nail bed injury is present or suspected.
- Carefully reconstruct the damaged nail bed with 6/0 chromic sutures (5/0 will work).
- Cover the nail bed well with Polysporin Ointment. Replace the nail and suture with nylon sutures.
- Drill the holes in the nail for the sutures using an 18 G needle.
- If the nail is missing use a silastic sheet, a plastic nail, or cut out a nail shaped piece of foil from the suture packaging.
- Remove all sutures and the nail at two weeks.
- In children, because of the flexibility of the nail, it may be possible to bend the nail back enough to inspect and even repair a nail bed injury without removing the entire nail.
- Exercise the DIP, starting immediately after the repair.

## **HIGH PRESSURE PAINT OR GREASE GUN INJURIES**

- Beware of the minimal damage present on initial presentation.
- The paint is injected at 1000 to 2000 psi and tracks extensively in the tissue.
- Refer immediately to a hand surgeon. This is a real emergency as there is a high risk of loss of digits.

## **CLOSED Mallet Finger**

- Due to disruption of the extensor tendon mechanism of the DIP, usually caused by a sudden blow to the tip of the extended finger.
- This may be due to a tendon rupture or avulsion of a small bone fragment from distal phalanx.
- Must x-ray these.
- If the avulsed bone fragment involved  $> 1/3$  of the articular surface, = surgery.
- If the avulsed bone fragment involved  $< 1/3$  of the articular surface, = splinting.
- Splinting for six to eight weeks, followed by two weeks of night splinting.
- Imperative joint is not allowed to flex at all in the six to eight weeks, else start again.
- Do not splint PIP; stiffness begins after as little as three days.

## **Skier's Thumb**

- This is due to disruption of the ulna collateral ligament of the MCP joint of the thumb.
- Clinically there will be pain and swelling over the area with point tenderness.
- An x-ray is required to exclude fractures or an avulsion fracture.
- The thumb must be tested for complete or incomplete disruption of the ligament. This may require local anesthetic prior to testing.
- If the joint opens laterally  $> 30$  degrees then a complete tear is presumed and surgery is required. This must be done urgently as after two weeks, surgical repair is difficult.
- Incomplete tears should be immobilized in a hand-based thumb spica splint for four weeks. Thereafter a splint should be used for sporting activities for a further six to eight weeks.

## **BITES:**

**N.B.** Be very careful in following up bites in Diabetic, Splenectomised & immunocompromised patients.

### **Dog Bites:**

- Tend to be crushing or tearing in nature
- Tetanus prophylaxis
- Vigorously scrub the wound with a surgical brush under LA followed by copious saline irrigation
- Antibiotic prophylaxis with a broad-spectrum drug, e.g. Amoxicillin/clavulanate is usually considered the first-line prophylactic antibiotic
- Inquire about the possibility of rabies

### **Cat Bites:**

- Tend to be a puncture wound injury with deceptively little damage
- Check carefully for signs of suppurative flexor teno-synovitis (fusiform swelling of the digit, tenderness along the flexor sheath, flexed posture, pain on passive extension) or septic arthritis (peri-articular pain increased with axial loading)
- Early infections should respond well to Amoxicillin and Clavulanic acid, otherwise I.V. antibiotics and drainage may be required

### **Human Bites:**

- Frequently seen with the punch injury over the MP joint
- X-ray must be taken to exclude tooth fragments or fractures
- Under local anesthetic the wound must be well cleaned and explored
- If there is evidence of joint involvement, then formal arthrotomy, irrigation of the MCP joint and
- I.V. antibiotics are required
- Antibiotic Cover: Orally – PenVK, Amoxicillin, Cipro, Cloxacillin. I.V. – Ancef and Flagyl

## **VIGNETTES**

### **Frostbite**

- Warm (in warm water 60<sup>0</sup> C.) for 20 to 30 minutes, if you are sure it won't refreeze. (E.g. mountain climbing situation.) Keep water circulating
- Do not burst blisters initially
- Aloe Vera (90% pure gel) topically for 24 hours, then Flamazine dressings
- Ibuprofen 400mg Q8h p.o.
- Pen VK p.o. prophylactically
- There is now evidence that using thrombolytics early can significantly reduce the extent of the ischemic damage. The current recommendations for this should be accessed

### **Non-healing abrasion or laceration**

- Look for a foreign body
- X-ray useful



### **Level of position of the digital neuro-vascular bundles on the fingers**

- Flex the finger
- Mark a dot at the apex of each of the lateral flexion creases
- Straighten the finger and join the dots!
- A good approximation to the position of the digital neuro-vascular bundles is the line joining the PIP and DIP flexion crease apices on the lateral aspect of the fingers.

### **The ‘Wrinkle test’**

- To determine if sensory function is absent
- Method: Soak digit in warm water for 10 minutes. If no wrinkling occurs, this implies a disruption of sensory supply to the finger pad

### **Burns**

- Aloe Vera gel Q2H for 24 hours topically, then change to Flamazine
- Aloe Vera gel is bacteriostatic and a PGE2 inhibitor, this helps to reduce vasoconstriction
- Use Ibuprofen to reduce the inflammatory reaction and increase blood flow into the affected area

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