The Whys and Hows of Hand Surgery on Posters

58 problem/discussion poster pairs

designed to meet the following objectives

for independent learning at intermediate and advanced levels:

1. Discuss a range of guiding principles of surgeon-directed diagnosis and treatment for common hand conditions.
2. Educate patients and colleagues regarding the basis for and the means of various surgeon-directed treatments.

3 hours of CE are credit available.

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Why do some incisions have more sutures than others?
Most skin injuries would eventually heal without sutures. Granulation tissue would form and contract with skin cells migrating across it. This is called secondary healing because the granulation tissue has to come first. Secondary healing takes weeks or months, and in the meantime underlying structures would likely dry out and become adherent to one another. So by bringing the skin edges into proximity to each other, healing is hastened, ie, primary skin healing.

So what affects the number sutures and their proximity to one another? More sutures absorb any tension wanting to pull the skin edges apart more diffusely, hence less risk of dehiscence. That is a good thing.

The closer the sutures are together, the more the skin is sealed, so the less likely blood is to escape from the wound. That is important for a vein or artery repair. For the skin, however, a water-tight closure is generally a bad thing, because I would rather have some blood in the dressing than having it inside the hand where it would result in swelling and pain and would promote stiffness. After that, it is mostly surgeon preference. Some feel fine with fewer sutures. Others prefer more. I generally prefer less, because if they achieve the same effect (uncomplicated wound healing), putting them in and taking them out take less time, and taking them out causes the patient less discomfort.
Hand and the surgery carts in a surgery center. Each color denotes a different suture material. Within a color, the separate boxes contain packets of that suture material of different sizes and attached to different sized needles.

Name the material of one nonabsorbable suture type and one absorbable suture type.

What is a major pro and con of each type?
Nylon is the most commonly used nonabsorbable suture, from faintly visible 10-0 used for digital vein anastamoses to nearly kitchen string diameter 3-0 used for some tendon repairs. Other nonabsorbable sutures include polyester (braided, Polydek) and polypropylene (monofilament, Prolene). A major PRO of nonabsorbable sutures is that they remain permanently strong. A major CON of nonabsorbable sutures in the skin is that they have to be removed, which the patient may find uncomfortable.

Gut (collagen from sheep intestine) is the most commonly used absorbable suture. Plain gut dissolves more rapidly than chromic gut, where the collagen is more highly cross-linked. Other absorbable sutures include polydioxanone (PDS) and polygalactin (Vicryl). A big PRO for absorbable sutures is that they do not need to be removed. A big CON is sometimes they may lose their holding capacity before the fibroplasia has taken over to secure the sutured tissues.

The choice of suture is rather individualistic—each surgeon likely has favorites based on the suture’s strength, handling and knotting characteristics, size of needle it comes on, what her mentors used, etc, etc.

[Wikipedia suture materials comparison chart] [Wikipedia description of needle and suture sizes]
What is this tan suture material? What are its merits over the usual, black nylon skin suture material? Why are the suture tails cut so short?
This is “catgut,” which is actually collagen that comes from sheep intestine. When exposed to living tissues, “gut” slowly dissolves, meaning that the sutures do not have to be removed. When used on the skin, it leaves a bit more of a scar than a stitch that gets removed. Gut is commonly used when it would be awkward or inconvenient to remove sutures, for instance in young children, on multiply-lacerated and hypersensitive fingertips, and on patients (like the one depicted), who lived at a distance and did not want to return for suture removal. Since these sutures are going to come out on their own, no need for long suture tails, which are used to grasp and cut the suture loop for removal.

Gut comes in 2 forms: plain and chromic. The plain type loses its strength after 7-10 days. The chromic type, where collagen crosslinks have been increased by tanning the gut in chromate, is less soluble, so it maintains its strength for 18-20 days.
Why the zig-zag incision?
Fact: Wounds contract as they heal, meaning that a 3 cm incision may be a scar only 2 cm long a year later. If such an incision was oriented transversely in the palm, such a shortening would not amount to much—it would just make the palm a little narrower at that point. If such an incision was oriented longitudinally, the shortening could prevent sufficient skin mobility to allow for full finger extension.

So here I wanted to have good exposure of the flexor tendons of the middle finger to remove a tumor, but a longitudinal incision would have led to a scar contracture. Here, portions of the incision are going to contract transversely (no problem) and other portions are going to contract obliquely (no problem for the transverse vector and a small but insignificant problem for the longitudinal vector).
What is the McCash technique for skin management after open Dupuytren excision? How does it work? How long does it take? How does the patient feel about it, at least initially?
The McCash technique, also known as the open-palm technique, is in this patient extended into his small finger. It is useful when there has been extensive, tenacious fixation of the contracted Dupuytren fascia to the overlying skin. Suturing the skin closed would create considerable tension on the skin edges, promote swelling and pain, and risk skin necrosis. Leaving the skin open allows it to heal by secondary intention—first granulation tissue forms. This contains myofibroblasts that contract and gradually pull the skin edges together. In the extreme case depicted here, it took 3-4 months for complete healing. In the meantime, however, there was no hematoma, no swelling, no pain, and no skin edge necrosis, so the patient recovered motion more quickly. Any patient treated with the McCash technique, however, is intuitively going to have doubts about the sanity of the surgeon and insecurity with the body’s wonderful capacity to heal itself, so it helps for the entire treatment team to frequently reinforce the virtues of the McCash technique to the patient.
Here’s a puffy hand. From the back it could be infection, fracture, maybe pseudogout. From the front, there seems to be rather focal bruising at the base of the little finger.

Do you know what is going on? The patient has a heritable disease and received some treatment for it a day or two ago.
This man has Dupuytren disease and has recently received an injection of collagenase (Xiaflex) to weaken and dissolve a section of the cord causing his little finger contracture.

This is a typical appearance of the hand 24-48 hours later. Eccymosis on the forearm and lymph node tenderness and/or swelling at the elbow and axilla are also common. This enzyme is powerful stuff—not only dissolving the Dupuytren cord but also weakening the nearby blood vessels (swelling and eccymosis) and causing an inflammatory response (lymph node reaction). Injected inappropriately, the collagenase can also dissolve flexor tendons leading to rupture.

On the day these pictures were taken, the patient first received an injection of local anesthetic into his palm, then when painless, the little finger was forcefully manipulated into extension, disrupting any residual Dupuytren fibers and typically recovering full digital extension. Then the therapist shows the patient stretching exercises to retain the new motion and fabricates a palm-based finger extension splint to use at night for 4 months.
This man has just had the second stage of an office treatment for Dupuytren disease.

After what treatment?
Why is the skin torn?
What to do for it?
The man has Dupuytren disease, and 1-2 days ago he had the contracted cord to his small finger injected with collagenase (Xiaflex). Then just now the surgeon has manipulated his contracted finger into extension to disrupt any residual Dupuytren fibers. Since the skin is stretched too and it is weakened from the collagenase, skin tears are common. They ooze a bit for a day or two and so require a gauze bandage. After the tear stops oozing, a Band-Aid suffices. Although it looks drastic, it heals by secondary intention (just like with the McCash technique), usually in 7-10 days, and causes no late problem. The patient may, however, require multiple reassurances that healing will occur without major medical attention.
Is this a keloid?
Why or why not?
What to do for it?
This fellow had a laceration on the back of his hand and is now left with this unsightly scar, which is appropriately called a hypertrophic scar, not a keloid. It is obviously hypertrophic, but it remains within the bounds of the originally injury. In other words, the healing tissue is not tumbling out over the edges of the laceration, which would be characteristic of a keloid. By the way, keloids are almost unheard of in the hand.

This hypertrophic scar might respond some to topical application of silicone liquid or gel. If that did not cause satisfactory flattening, then excision of the scar and careful skin closure and wound care would likely diminish the disfigurement.
problem

Match:
- subungual hematoma
- malignant melanoma
- chronic paronychia
- acute paronychia
- mucous cysts
1. Acute paronychia—bacterial nail fold infection. This needs surgical opening of the cuticle to let the entrapped pus (abscess) escape. Warm water soaks and oral antibiotics then allow healing.

2. Chronic paronychia—it looks like this guy is a nail biter, and he has destroyed the cuticle, which normally seals the nail plate to the skin. Without the cuticle, bacteria can find a warm, moist home in the nail fold and cause chronic inflammation. Chronic paronychias are usually treated by a dermatologist.

3. These are mucous cysts. They arise in response to osteoarthric bone spurs at the DIP joint. In this photo, one of the cysts has been pressing on the nail plate, which causes a trough to form. Removal of the bone spurs precludes new cyst formation, and without the cyst pressing on the germinal matrix, a normal nail emerges.

4. Black spots or streaks under the nail should be considered to be malignant melanoma until proven otherwise. This proved to be a melanoma on biopsy and was successfully treated by nail bed excision and skin grafting onto the dorsal cortex of the distal phalanx. More advanced melanomas would require amputation through the proximal phalanx.

5. This is a subungual hematoma, which is only distinguished from a melanoma by a clear history of an injury and migration of the dark patch distally with nail growth.
Matching

wart, pyogenic granuloma, basal cell carcinoma, squamous cell carcinoma, malignant melanoma
Definitive diagnosis of skin lesions is made by biopsy and microscopic evaluation, but some general guidelines help with the visual, tentative diagnosis.

A. Basal cell carcinoma. This skin cancer often appears on sun-exposed areas of older people and is red or silvery. When small, it could be mistaken for an acne scar. When large there can be a central crater with a heaped up silver edge.

B. Malignant melanoma is not as common as squamous and basal cell carcinomas but accounts for about 75% of deaths related to skin cancer. It is usually asymmetrical with irregular borders, has variable density of pigmentation, and enlarges over time.

C. Squamous cell carcinoma. It can be quite varied in its appearance. Often it is a skin plaque or an ulcer with reddish, hard, raised edges.

D. This nasty lesion is the fastest growing of the bunch and actually is the most innocuous. It is a pyogenic granuloma—an exuberant overgrowth of granulation tissue in response to a minor skin injury. Repeated applications of silver nitrate may suppress it sufficiently for skin to grow across the wound, if not, local excision is typically curative.

E. This is a common wart. It is raised, and the center is rough. It most commonly occurs on the hands and the patient may have or have had multiple ones. These are caused by a virus, and home remedies and folk remedies probably have about as much success as doctor-prescribed treatments. Excision can be problematic because a spread of the virus can lead to satellite warts along the healed incision.
These fingers all have the same problem.
These are Herpes simplex viral infections, known as herpetic whitlows, which doesn’t really help much understanding them. Herpes is very common in saliva, and before health care workers started wearing gloves when around any sort of body fluid, herpetic whitlows were occupational hazards of respiratory therapists, dentists, and anesthesiologists.

These infections are restricted to the skin and start off as small blisters (left, and look closely at the pulp on the center image), which break open. These can be quite painful and can be mistaken for felons, but here the pulp is entirely soft. Antiviral medications can be administered, but herpetic whitlows are self-limited and resolve without any specific treatment over several weeks.
These are 4 common findings of an office treatment for a common disease. Describe the findings. What is the disease? What treatment did these patients receive a day or two ago?
Ecchymoses are seen in two palms and as far proximally as the elbow in one limb. Diffuse dorsal swelling is present, and a skin tear with oozing dark blood is evident.

It is easiest to make the diagnosis from the upper left photo, Dupuytren disease.

All four hands have been injected a day or two previously with collagenase (Xiaflex). This potent enzyme digests the collagen in the cord and obviously also in some surrounding capillaries. The capillary damage accounts for the bruising and swelling. The doctor takes care to inject the small quantity (.20-.25 ccs) entirely into the cord, but some may leak out and attack the collagen in the skin. Also the skin is tight from the longstanding contracture, so 20-30% of patients get skin tears when the finger is manipulated into extension 1-2 days after injection. Although the tear looks nasty and will ooze dark blood for a day or two, after that soap and water and Band-Aids suffice, and it heals without incident in 7-10 days.

Following manipulation and breaking any of the cord fibers not entirely digested by the collagenase, the patient needs to do daily stretching exercises and wear a night-extension splint for 4 months to maintain the gains obtained by the chemical digestion of the cord.
Why is the skin on the forearm textured?
What benefit does this method of coverage afford that makes the method useful?
This is the appearance of a mature meshed, split thickness skin graft. The raised bumps of slightly lighter color are where the open areas in the mesh were and where epithelial cells migrated from the graft onto the granulation tissue. It is not particularly aesthetic, but the two major advantages of meshing a graft are
1. Smaller donor site
2. Hematoma cannot form under graft, which would lift it off of its bed and result in failure of the graft to take.
What causes these changes?
There is no common denominator here, just 3 common skin changes you should be able to identify by sight alone.

Cortisone injections cause dermal and fat atrophy, here there is hypopigmentation but no skin flattening or depression from fat atrophy. This injection was for a ganglion.

These are knuckle pads, usually but not always associated with Dupuytren disease. Have a look at the patient’s palms.

This is an eccymosis following medial epicondylectomy for cubital tunnel syndrome. Rather common and certainly unsightly, but not serious. Advise the patient that the eccymosis will migrate proximally and turn yellow-green before resolving in 1-2 weeks. Area may be tender in the meantime.
How would you describe this scar from a laceration? (If you are thinking about using the K word, think again.)
This is a hypertrophic scar. Although wide and raised, the scar remains entirely within the borders of the original injury.

The K word you suppressed is keloid, which is an exuberant scar reaction that extends beyond the borders of the original injury and almost never occurs in the hand.
Describe the suture technique used here. Choose one word from each column

<table>
<thead>
<tr>
<th>Simple</th>
<th>Running</th>
<th>Nylon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal mattress</td>
<td>Continuous</td>
<td>Silk</td>
</tr>
<tr>
<td>Vertical mattress</td>
<td>Interrupted</td>
<td>Stainless steel</td>
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</tbody>
</table>
The sutures on the previous slide are simple, interrupted nylon stitches.

Simple means that the needle passes down through the skin on one side and up on the other side.

Interrupted means that after each down and up, a knot gets tied. By contrast, a running (aka continuous) suture would have a knot at each end and a long run of downs and ups, similar to a hem in clothing.

The suture material is nylon, which is the commonly used material for suturing skin. It is cheap, easily handled and tied, resistant to infection, and reasonably strong.

Silk and stainless steel sutures were used more often before the development of nylon. Silk handles well and ties a very secure knot. Because it is made of many fibers, its use risks infection because bacteria can hide among the fibers.

Stainless steel is difficult to handle and tie, but it is awesomely strong.
Here is a forearm that recently had fasciotomy for compartment syndrome. Obviously it is still swollen, but the muscle is pink and granulation tissue is present on the tendons and fat.

Now what is different? Is this a good thing or a bad thing?

What do you think this will look like in 6 months?
It is a good thing. This is a split thickness skin graft, about 12/1000 of an inch thick—about ¼ the thickness of a sheet of paper. You can see that it is transparent—epidermis and scattered superficial dermis. In 4-5 days, capillaries will grow into the dermis and provide a blood supply. The granulation tissue will contract and reduce the size of the wound. Without a skin graft, this wound would eventually contract, but skin grafting markedly hastens the process, and lets the patient focus on care of other problems, for instance the forearm fractures. See the external fixator.

Now that the fracture is healed and the skin graft is mature, the forearm is soft and supple with the previously ischemic muscles now their normal size. At this point for the sake of appearance, the skin graft can be excised and the skin edges sutured, leaving only a linear scar.
What are these?  
Hint: One is a normal finding. The other two are not.
The distal one, close to the thumb MP joint is a sesamoid bone, buried in the volar plate and entirely normal. Patients’ eyes often settle on these when they are looking for abnormalities on their hand x-rays.

The other two are not so dense, have squarish corners, and are foreign bodies, maybe windshield glass. (Most all glass, regardless of its lead content, shows up on x-ray.) If these are deep and nontender after several months, it is best to leave them. Looking for them is like searching for a needle in a haystack.
The patient does not like this bump 3 months after sustaining a boxer’s fracture. What can you tell him to expect? He wants to be a movie star and is stressed out about his image? (What was he thinking when he fisted his buddy?)
Offer reassurance. With a fracture, especially one treated by closed means, the body makes a bunch of callus to quickly stabilize the fragments. Once they are stabilized, the extra callus gets modeled away over 6-12 months. At that point the bump will be imperceptible and the patient can continue with his quest for stardom.

As an example of bone remodeling, here is a humerus fracture demonstrating normal healing and remodeling.
You just slipped and fisted a wall, at least that is your story and you seem to be sticking with it. While attempting a fist now, it is painful, but no scissoring is apparent. Your insurance stinks and you cannot afford to miss work. How would you treat yourself? (The thumb is fine.)
Your fifth metacarpal head is folded into your palm. It was here before you “fisted the wall.”

This is an apex-dorsal boxer’s fracture, an impacted, angulated fifth metacarpal neck fracture. Because it is impacted, it is stable, and you know clinically that there is no rotation deformity because you would note scissoring. Because the 5th MC-carpal joint has about 25 degrees of E/F, a fifth MC head depressed into the palm is not a functional issue. This fracture heals in about 3 weeks. Wear a canvas wrist splint, not to immobilize the fracture but to remind you not to fall down, and go about your business. Full motion will likely return. When you show your fists at parties, your fifth MC head will be depressed, so don’t go to parties or at least don’t go to parties where people want to compare the shapes of your fists.

Yes, the books say to treat this in an ulnar gutter splint with the MP joint in flexion, but in reality, many of these never get treated at all and end up just fine, except for the depressed fifth MC head.
Look closely at both images before making a diagnosis. It looks like there is extra bone on the lateral, and maybe a transverse linear lucency in the supracondylar area on the anteroposterior view. Diagnosis? Treatment? Start when on the treatment?
Those opaque clouds on the lateral is extra bone. Hmm, maybe heterotopic bone following a stroke, maybe in response to an infection. But wait, there is a transverse supracondylar fracture on the right. The fracture is subtle and may not have been x-rayed early on, or if x-rayed, possibly missed. In the following 4-6 weeks, the bone is healing and is clinically solid, but the elbow is probably stiff. Early active and passive exercises are warranted. The callus may preclude full recovery of motion, but early motion will restore capsule pliability and make convalescence easier, should excision of heterotopic bone be necessary...
Arrange these images in chronological order? How long do you figure it took to get from the earliest image to the latest one? What was the bone doing during this time?
B D C A

B: This is a fresh transverse, midshaft humerus fracture with a small comminuted piece, which is the bright white crescent at the fracture site. No new bone yet.

D: The fracture ends look about the same but note the halo of whitish material encircling the fracture site. This is immature new bone, which is beginning to stabilize the fracture. At this point the fracture is probably stable unless the patient sneezed or tried lifting a gallon of milk.

C: More callus, denser. Repair site is stronger. The spikes on the ends of the shaft are now rounded, ie, remodeling is underway.

A: The fracture ends are no longer visible and the callus is itself remodeling to return the bone gradually to its original shape. Amazing.

The time from B to A is about 3 months for a humerus, much faster for a metacarpal, longer for a tibia.
What happened here?  
Any way to avoid it?  
How could have this complication been avoided?  
Remember, there is no such thing as a free lunch!
A simple transverse diaphyseal fracture was plated and then the plate broke, the bone angulated, and is now healing (see the cloud of callus in the concavity opposite the plate. It is always a race between fracture healing and hardware failure, in this case by metal fatigue and plate breakage. In other cases it might be by screw loosening and pullout. Sure you could possibly avoid it by using a stronger plate, but it is not only going to by bulkier and possibly impede function. It would also shield the fracture site from any stress at all, which will delay fracture healing. Then after the plate is removed, the bone under the plate will be weak from the stress shielding and be prone to pathological fracture. 😞 

So the race goes on. Surgeons seek the lowest profile hardware that predictably will withstand some early, gentle motion and remain intact for the time expected for fracture healing. Smoking, however, confounds the issue.
What is this?
What is being treated?
Which hardware went in first?
Then what?
Which hardware is definitely coming out today?
Which hardware will likely remain forever unless it causes problems?
These are intraoperative fluoroscopic views taken during open reduction and internal fixation of a distal radius fracture. The two rake-like items are the ends of a self-retaining retractor, one side holds the radial artery and lateral skin laterally while the other side holds the FCR, median nerve, and digital flexor tendons medially so the surgeon can see the volar surface of the distal radius.

Once the retractor is in, the surgeon can manipulate the radius and temporarily hold it in a reduced position with the obliquely placed Kirschner wire (single black line). The K-wire holds the fracture in place while the plate and screws secure it soundly. The retractor will definitely come out before skin closure. The K-wire may come out today or in a few weeks. Unless the plate causes problems (crepitation or rupture of the overlying tendons), it is usually left in forever.
What is the big, white claw? What are the two white rings inside the circle? What would your hand surgeon do?
This is an axial computed tomography cut through the distal radius and ulna. The ulna is entirely round, the radius has a fracture through its volar lip. It is the volar lip because Lister’s tubercle accounts for the “peak” seen dorsally.

The wrist is encased in a plaster of Paris sugar tong splint, meaning that plaster slabs extend from the palm, around the distal humerus and onto the dorsum of the hand, not only immobilizing the wrist from E/F but also the forearm from P/S.

The carpus follows the small volar lip fragment anteriorly and only open reduction and internal fixation can restore the carpus and the small volar lip fragment to their anatomical alignment on the end of the radius. Once the fragment is buttressed into place, early therapy minimizes risk of wrist stiffness.
This person fell on her outstretched hand. The posteroanterior view looks pretty normal except for an ulnar styloid fracture, which should make you suspect that there is more going on. The lateral view shows a distal radius volar lip fracture. Is this an injury for a canvas wrist splint and a pat on the back, or are major consequences looming without surgery?
Remember that the volar radiocarpal ligaments are the strong ones and they keep the carpus aligned on the forearm. Here there is a volar lip fracture of the radius, and the volar radiocarpal ligaments are attached to this fragment. So the farther the fragment displaces, the farther the carpus is going to follow the fragment off its normal alignment on the radius. In other words, this is a fracture dislocation. Supporting this volar lip fragment and the carpus resting on it would be impossible with a cast. So open reduction and internal fixation with a volar buttress plate to push this articular fragment (with its ligament attachments and associated carpal bones) back in place. Early motion after surgery will minimize stiffness in these critical volar radiocarpal ligaments.
Notice anything wrong here? What do you think happened? Do you think this is painful? Any hope with therapy? Any call for surgery? Best left alone?
This fellow had a distal radius fracture that malunited with marked shortening and loss of radial tilt, hence the prominence of his ulna and the radial translation of his wrist and hand on his forearm. Note too on the lateral that his wrist and hand are translated dorsally with respect to his forearm. You can surmise from the lack of swelling and the presence of full finger motion that this is functional and probably entirely painless, although rather unsightly. Trying to restore the normal anatomy with an osteotomy of his radius and bone grafting and plating would be a monumental undertaking and risk stiffness, nonunion, and pain. I would try to persuade the patient to accept a functional albeit unsightly result. Perfect is the enemy of good.
Do these x-rays and these CT scans belong to the same patient?
Impossible. The x-rays show a displaced extra-articular distal radius fracture: shortened, loss of radial tilt, loss of volar tilt, and translated laterally and dorsally, BUT the distal fragment is in one piece. Now look at the CT. The distal radius is mush—multiple fragments and no suggestion of a distal articular surface at all. The patient on the left would do well with a volar locking plate or even with closed reduction and percutaneous pinning. The one on the right needs an external fixator, which would allow the soft tissue envelope to pull the fragments back into some semblance of a distal radius.
Why do you think the doctor chose K-wires for this distal radius fracture rather than just a cast or a volar locking plate? The K-wires require a cast for the duration of their placement, and the pin tracks can get infected.
This fracture was extra-articular, not comminuted, and in a younger patient without osteoporosis. The fracture was initially displaced, implying that it would likely slip out of alignment if merely casted. So the K-wires secure the reduction, and the cast for 6 weeks protects the K-wires, which are then removed.

A volar locking plate entails more extensive surgery than percutaneous placement of the K-wires and risks tendon rupture. A plate would, however, be better than K-wires if the bone was osteoporotic, if the fracture was comminuted, or if the patient had a compelling need to be cast-free.
So, a radial shaft fracture. But that is just half of it. What Italian’s name is associated with this fracture/dislocation? What is dislocated.
Think of a ring of some rigid material, for instance a ring of ice that was frozen in a Bundt cake pan and then removed. Can you break the ring in just one place? Nope. To distort it sufficiently in one place, its brittleness is going to cause it to distort in another location as well. The same is true with the pelvis. If you have a sacroiliac dislocation on one side, the ring has to give way in a second location as well.

The radius and ulna in the forearm are also a (rather distorted) ring and behave the same way. Hard to disrupt the ring in just one place. But rather than the line of stress relief going through a bone the second time, here it went through the distal radioulnar joint. Note on the lateral x-ray that the DRUJ is entirely separated, obvious on the lateral, and present on the posteroanterior view because of the overlap.

This is a Galeazzi fracture dislocation, untreatable by nonoperative means. The strategy is first to plate the radius. Once its anatomy is restored, the distal radioulnar joint may be stable, although unlikely here because of the distance of disruption. So reducing the DRUJ and cross pinning it for 4-5 weeks is the normal treatment. Pinning it for a shorter length of time risks chronic DRUJ instability. Pinning it much longer risks permanent loss of forearm rotation.
These x-rays are of two different children, both who fell and broke their wrists. How would you describe each fracture? (Don’t let the open epiphyseal lines confuse you.) Which child is older? Which one can go immediately into a cast and which one needs an “adjustment” then casting?

An adult needs 6 weeks in a cast for a distal radius fracture, same for these striplings? Should either one of these children plan on much therapy after cast removal?
Torus fracture, also known as greenstick fracture, occurs in children 3-8, does not even need a cast providing the patient promises not to fall down for the next 3 weeks, so... they all get casted for 3 weeks. Then full recovery without need for any hand therapy.

Epiphyseal fracture, usually in children 8-12. Here the epiphysis and a wedge of metaphysis have been pushed off, and sedation and a closed manipulation followed by casting for about 3 weeks is indicated. Again, no rehab anticipated. Kids are resilient.
What treatment would you recommend for this fracture in a
1. 19 year-old portrait artist?
2. 40 year-old dentist?
3. 75 year-old journalist?
You saw the horizontally-oriented nondisplaced scaphoid waist fracture, right? The fact that it is not displaced implies that there was not major capsular stripping. Being transverse, it is stable and unlikely to displace. So it has an excellent chance of healing, particularly because it is well away from the proximal pole. The fracture will probably heal in 6-8 weeks. So a cast is fine for the 19 year-old, low demand patient. Eight weeks away from practice would probably be economically devastating for a dentist, so I would recommend percutaneous placement of a screw and back to work unsplinted in a few days. Scaphoid nonunion advanced collapse (SNAC) takes 10-20 years to develop, so the consequences of a nonunion in the oldster... Do the math. A nonunion is not going to be an issue for him. Therefore, I would give him a brace for comfort until the swelling subsided. Then he would likely be asymptomatic for the rest of his life unless he took up wood chopping, which does not appeal to most septuagenarians.
How would you describe this fracture: transverse, short oblique, long oblique, spiral, comminuted, bad, not so bad?

Why is this fracture sometimes called a nightstick fracture?

What treatment is best?

Any guestimate on time to heal and return to golf?
This is a spiral fracture of the ulnar diaphysis. It may look comminuted, but the fracture line just takes a twist, so there are only two pieces, but you see some edges of the fracture twice as the x-ray cannot discriminate between the anterior and posterior cortices.

Imagine your instinctive move to protect your face if somebody was getting ready to whack you with a nightstick. You put your forearm up, and they whack your ulna instead.

These heal fine in a cast and typically with recovery of full function, but because of the dense cortical bone and small medullary cavity (ie, not a terrific blood supply), it may take 12 weeks to heal. So sometimes if a patient does not want or cannot afford to be casted that long, open reduction and plate fixation is done. The ORIF does not hasten healing, it just stabilizes the fracture internally so that the cast is unnecessary, at least until the patient gets into another brawl.
How long ago do you think this fracture occurred?
What treatment has been applied?
What treatment should be provided now?
The metacarpal is trying its hardest to heal this fracture, but the patient is not cooperating. Note that the fracture line is fuzzy, not sharp like broken glass. A fresh fracture has nice sharp edges, because bone, like glass, is brittle. Some remodeling has already occurred, implying that this fracture is probably at least 3-4 weeks old. Then look at the new bone being laid down. All 4 of those spikey corners is new bone.

The patient probably has not immobilized his hand at all, because usually with a modicum of care, this fracture should be clinically solid in 4 weeks. Placing an ulnar gutter splint for 2-3 weeks and giving the patient a stern talking to should allow this fracture to heal.

This is a fresh fracture. Note how crisp the fracture edges are.
How would you treat this fracture in somebody you can trust? In somebody you cannot trust? In yourself?

It is essentially non-displaced. The distal fragment is suspended by the intermetacarpal ligaments running to both the index and ring metacarpals.
The alignment here is not likely to shift, ie, the fracture is in a stable and totally acceptable position. The only thing it might do would be to rotate and cause scissoring of the fingers when making a fist. It will be clinically united in about 3 weeks, so in the interim, the patient only has to be protected from herself/himself.

Since I trust myself to hold off on climbing walls and moving pianos for 3 weeks, I would buddy tape my middle and ring fingers, watch for scissoring, and maybe wear a canvas brace or an Ace bandage to remind me to slow down a bit.

For a teenage boy, probably a short arm cast and buddy tape.
Can you get this fracture by falling down?
What do you think the pulp and the nail bed look like?
What treatment do you advise?
Anticipated outcome?
How long until he can use this digit to button his shirt comfortably?
The lever arm in the distal phalanx is far too short to get this segmental fracture by anything short of a direct crush. Usually even car doors are sufficiently forgiving not to break the distal phalanx, or at least not cause much more than an innocuous tuft fracture.

This was a major impact by something hard and edgy, a concrete block for instance. So anticipate some nail bed lacerations and at least contusions of the pulp if not lacerations there as well.

The bone here heals fine, but the well-innervated soft tissues will be painful for many months. Eventually, order will be restored, although a nail deformity might be permanent.
Problem: Keep looking until you see 3 fractures. Plausible mechanism of injury? Means of treatment? Anticipated outcome?
These are transverse, extra-articular base of proximal phalanx fractures, quite likely sustained in a fall with fingers hyperextended. These are stable fractures. The one in the middle finger is nondisplaced so only needs protection. I would inject some local anesthetic at the base of the ring and small fingers and nudge those two fractures back into alignment and then buddy tape all three injured fingers to the index. Immobility risks adherence of the extensor mechanism to the fracture sites, so I would encourage immediate, gentle active and passive making of a fist. Recovery of full motion is likely.
problem

Lots of lines here.
What is joint?
What is epiphysis?
What is normal?
What is injured?
How to treat?
Epiphyses
Joints
Injury

There is a fracture through the epiphyseal plate in the proximal phalanx and a small triangle of metaphysis remains with the epiphysis while the main part of the proximal phalanx has shifted slightly. The alignment is fine, so the thumb needs protection against further injury for several weeks—a thumb spica cast for the rough and tumble type, a thermoplastic brace for the angel darling.

Give 3 reasons why it was a good idea to openly reduce and internally fix these fractures.

Give 2 risks of open reduction that would not be encountered by cast treatment.
These are simple, long oblique (fracture line >3 times bone diameter), extra-articular fractures. Since we can’t see the soft tissues on x-ray, we can’t say for sure about whether the skin was involved.

Benefits of open reduction and internal fixation:
- Restoration of anatomic alignment
  - Best appearance
  - Interosseous muscles can function at their normal length
- Immediate rigid fixation
  - Allows for early soft tissue rehab
  - Minimizes pain because bones ends are not moving
  - Eliminates cast problems: swelling, poor hygiene, discomfort

Risks of open reduction and internal fixation include:
- Further devascularization of the bone ends, slowing healing
- Failure to achieve rigid fixation because of faulty technique or unexpected comminution
- Infection
- Hardware complications necessitating eventual removal
These hands don’t look quite right. What are the diagnoses? What types of surgery might help?
Median nerve palsy  

Ulnar nerve palsy

Median and ulnar nerve palsy (all fingers are clawing)

Traditionally tendon transfers would be appropriate to improve opposition and to relieve clawing.

In recent years, nerve transfers are gaining popularity. For instance taking the anterior interosseous nerve away from the pronator quadratus in the distal forearm and connecting it to the motor branch of the median nerve (which would have to be found in the palm and traced back to the level of the pronator quadratus.
What common theme ties these photos together?
Testing peripheral nerve function.

The Durkan median nerve compression test renders the median nerve momentarily ischemic near the carpal canal. If the nerve is already irritable from carpal tunnel syndrome, the test will promptly reproduce the patient’s numbness and tingling.

The Froment key pinch test demonstrates collapse of the left thumb IP joint into flexion when the ulnar-innervated intrinsic muscles do not balance the force of the FPL. Not only is the pinch weak, it is ineffective because it presents only the thumb tip rather than its entire pulp as a work surface against the pinched object. Normally the intrinsic thumb IP extensors and the extrinsic thumb IP flexor work together to produce forceful pinch against the thumb pulp as seen in this patient’s right hand.

When the thumb IP joint is unstable in flexion during tip pinch, you know that the FPL is not working, and here in this patient’s right hand, neither is the FDP to the index. This is the characteristic pinch posture seen with an anterior interosseous nerve palsy—collapse into hyperextension of thumb IP and index DIP joints.
problem

Matching time
complete brachial plexus palsy
spinal accessory nerve palsy
axillary nerve palsy
suprascapular nerve palsy
long thoracic nerve palsy
Long thoracic nerve palsy: scapular winging from absent serratus anterior. Trapezius contour is normal.

Axillary nerve palsy with absent deltoid contour to shoulder.

Spinal accessory nerve palsy with scapular winging and absence of the trapezius contour from neck to acromion.

Suprascapular nerve palsy with atrophy of supraspinatus and infraspinatus.

Complete BP palsy: no deltoid, supraspinatus, infraspinatus, rhomboids, triceps.
What condition were these three implants designed to treat? How effective was the treatment in these three instances?
discussion

Left: silicone trapezium replacement. It is nearly cylindrical with a stem inside the first metacarpal. Here, the implant itself looks OK, but see the cysts in the scaphoid, capitate, and trapezoid. These indicate an inflammatory reaction to small particles of silicone that have been sheared off the implant: silicone synovitis. The inflammation will not subside until the implant is removed.

Center: total joint in the form of a metal ball and a faintly seen polyethylene socket. Both are loose and likely painful.

Right: a ceramic ball that has slipped from the concavities that were created for it in the distal portion of the trapezium and the base of the first metacarpal.
This man fell 10’ from a scaffold. What is that sticking through his skin? If his radius is broken, would you advise open reduction and internal fixation today? What about wound debridement? What about antibiotics?
That is the end of the ulna sticking out through the skin. You can assume by the alignment of his forearm that he has a severely displaced distal radius fracture. Since the ulna is contaminated with bacteria, placement of a plate and screws on the radius today would greatly increase the risk of infection. Rather, thorough wound irrigation and debridement today to remove most of the bacteria and IV antibiotic to ideally remove the remainder would be in order. At least for temporary stabilization, an external fixator would be helpful. In a week or so when it is clear that there is no infection, volar plating of the radius would allow for removal of the ex fix and for initiation of early rehab. Once the radius is restored to its normal alignment, the distal radioulnar joint may be stable. If not, pinning of the radius to the ulna in supination for 2-3 weeks would help the DRUJ regain its stability.
These photographs were all taken in the 1980s. They all represent different manifestations of the same disease. What disease? What has changed in the interim that we only rarely see such drastic deformities any more?
Rheumatoid arthritis.

The medications now are much better. First methotrexate came along in the 1990s. More recently the tumor necrosis factor inhibitors (TNFIs) directly counter the growth factor that cause the destruction. The TNFIs that have revolutionized the care of these unfortunate patients include Enbrel and Remicade.
The Whys and Hows of Hand Surgery

Match:
- Darrach resection
- Sauve Kapanji
- Intercarpal arthrodesis
- Total wrist fusion
- Radiocarpal fusion
- Trapezium excision
- Proximal row carpectomy
The Whys and Hows of Hand Surgery

discussion

Match:
- Darrach resection
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- Total wrist fusion
- Radiocarpal fusion
- Trapezium excision
- Proximal row carpectomy
This patient poked a safety pin accidentally into her ring finger 3 days ago. It is now swollen diffusely, painful along the flexor tendon sheath. The patient is unwilling to move it, and passive DIP e/f causes marked pain.

What treatment do you recommend?

If treated correctly and promptly, what outcome do you expect?

If ignored for several more days, what outcome do you expect?
This is acute bacterial flexor tenosynovitis. The safety pin introduced skin bacteria into the flexor tendon sheath, where they thrive on the nutritious synovial fluid. So the infection tracks up and down the extent of the flexor tendon sheath and accounts for the presence of Kanavel’s 4 classic signs of this problem: symmetrical swelling, sheath tenderness, limited motion, and pain on passive gliding of the tendons in the sheath. This patient needs immediate incision and drainage and antibiotics. With prompt treatment, probably full or near full recovery of tendon gliding and motion can be expected. If neglected, the bacteria will begin to digest the tendons, which will lead to a lifetime of stiffness and woe.
What sort of image is this? See anything you recognize?
This is an MRI, taken through the plane of the palm. You can tell it is an MRI and not a CT scan because the soft tissues are well demarcated. A CT scan shows the bones well but all the soft tissues are indistinguishably blurred.

1. Camper chiasm in FDS tendon
2. Hamate hook
3. Scaphoid
4. Radial styloid
What is this disease called, which is worsened if not caused by smoking?
Thromboangiitis obliterans

Thrombo: nothing good implied, ie, thrombosis
Ang: ok, means artery
Iitis: nothing good here either, ie, inflammation
Obliterans: nothing good here, ie, obliteration.

So translated it means clotted, inflamed, obliterated arteries. Yuck.

If that happened to digital arteries, you could expect ischemia and necrosis.

Also known as Buerger’s disease.
Here is the same hand several minutes apart. Describe the color in each. The patient is otherwise entirely healthy. Diagnosis? Treatment?
The fingers on the left photo are blanched, probably cold, achy. Then the arterial spasm resolves and the fingers on the right are hyperemic proximally yet with some venous congestion and cyanosis distally. This is Raynaud’s phenomenon, vasospasm, classically triggered by cold or stress. When it occurs as part of another disease, frequently systemic lupus erythematosus, it is called Raynaud’s syndrome (secondary Raynaud’s). But it can also occur when there is no known underlying disease. Then it is called Raynaud’s disease (primary Raynaud’s). The fingers first turn white (ischemic) from the arterial spasm, then blue (some deoxygenated venous blood drifts into the capillaries, then red as the vessels dilate and the blood rushes in, often with tingling, throbbing. Avoidance of cold exposure is the first line of defense. Calcium channel blocking medication used for high blood pressure is the next step. Surgical sympathectomy may be helpful in resistant cases.
Contrive a scenario to account for this photo. Note that the thumb tip is nice and pink and that the critter seems fat and happy. (Can’t you see him smiling?)
This patient had a distal thumb amputation and replantation with inadequate veins. The thumb was becoming congested because there was slow outflow. With congestion, the pressure builds up on the arterial anastomoses, and then it clots. Then the replant fails.

The medicinal leech hangs on for 10-15 minutes and removes several ccs of congested blood. More importantly, it deposits an enzyme from its saliva into the wound. The enzyme is a potent anticoagulant, so the wound oozes venous blood slowly over 4-8 hours. This temporarily decongests the replanted part and relieves pressure and slow flow at the arterial anastomoses. Repeat leech application several times daily over 3-5 days allows time for new capillaries to grow across the injury site and provide a permanent, internal solution for the venous insufficiency.
This fellow lost his mittens on a very cold night and presented to the ER with cyanotic fingertips and some abrasions. Rapid rewarming in 104°F (40°C) water returned some circulation to his fingertips but produced some blisters, which progressed in ugliness over 12 days despite daily whirlpool and Silvadene (silver sulfadiazine) treatments. Diagnosis? Prognosis? Should he sell his guitar? Why aren’t his thumbs involved?
Frostbite! Rapid rewarming is the initial treatment, after that, patience is usually rewarded. Blisters form, and the old blood in the drying blisters masquerades alarmingly as deep tissue necrosis, but even at 12 days you can see some of the blisters peeling away with healthy skin underneath. Hence the party line is to perform amputations only after the natural healing has fully declared itself. For this fellow, even the subungual blood deposits should clear over several months. The thumbs are thicker and shorter so they stay warm longer.
What are those stringy thingies hanging from the thumb on the left? Which thumb got replanted and which one had to be thrown away? Why? Which patient will ultimately have better function?
Those strings are the digital nerves. So although the other tissues *look* rather cleanly divided, there had to be a large jerking component to this injury to avulse the nerves out of the palm. So for three reasons, this amputation is best closed. 1. The vessels also sustained avulsions and would be difficult if not impossible to successfully repair. 2. The thumb would likely always be insensate because of the diffuse nerve injury. 3. The patient’s function will be fine by having the amputation site closed and working with a thumb that is short by the length of the distal phalanx.

This injury looks more promising for repair. No dangling nerves or tendons—ie, a sharp injury, ie, narrow zone of injury. This injury is through the proximal phalanx, so closure of the amputation would leave a dysfunctionally short thumb.

So which patient will ultimately have better function? The patient on the left with a slightly short but entirely sensate amputation stump? Or the one on the right with a thumb of normal length but probably not more than return of protective sensation following digital nerve repair? I say it would be a toss-up, both should have reasonable function. Mr. Left will not be able to palm a basketball. Mr. Right will likely have some cold intolerance.
problem

These patients are almost ready for their operations: the one on the left for a surgery in the ring finger, the one on the right for a surgery on the forearm or hand.

Name the major benefit of using the devices you see.

Name 3 potential problems.
These devices occlude circulation distally, which allow surgery to proceed in a bloodless field. This privilege afforded extremity surgeons allows for superior visualization of the anatomy and pathology without having structures and planes obscured by blood. A tourniquet also precludes losing blood during surgery.

Problems can arise. Use of a Penrose drain (1” wide rubber band) at the base of the finger works for short cases such as removal of osteophytes or digital tumors. The pressure applied by the Penrose drain is unknown, so the digital nerves would be at risk from application of the tourniquet for more than 15 minutes or so. The worst problem with using a tourniquet at the base of the finger is the risk of sending the patient home with the tourniquet still in place under the bandage. As implausible as that might seem, it happens, and usually results in digital necrosis, amputation, and an exceedingly unhappy patient.

The pneumatic tourniquet depicted on the upper arm is essentially a blood pressure cuff attached to an air pump and a timer. The pressure can be controlled in a range of 200 -300 mm mercury, sufficiently above systolic pressure to maintain a dry field but not so high to injure nerves. It can be left in place for two hours without causing any tissue damage, either distally from ischemia or immediately under the tourniquet from ischemia and pressure. If the tourniquet is not accurately calibrated (for instance reading 250 but actually squeezing at 500 mm mercury) and/or if the tourniquet is not released at 2 hours, permanent tissue damage can occur.

If the pneumatic tourniquet is placed too close to the elbow, it may press the poorly padded ulnar nerve directly against the bone and cause a palsy.

Efficient and effective hand surgery without use of a tourniquet would be difficult, yet, like with most tools, a tourniquet must be used with great care.
Right, you might surmise that the patient on the left has an anterior wrist ganglion, but would your opinion change when you know that both patients have the same problem? You might not be able to diagnosis this by inspection alone, but resting your fingers lightly on either mass would promptly bring you to the diagnosis. Can you provide a common scenario that would lead to these findings?
These are both radial artery aneurysms, or to be precise, pseudoaneurysms. An aneurysm is when all of the layers of an artery balloon out, unfortunately too common in the cerebral and carotid arteries and in the aorta. A pseudoaneurysm follows an injury, in the depicted cases from arterial needle punctures, where blood leaks through the intima (inner layer) and expands the outer layers of the artery. Lightly touching one of these reveals a strong arterial pulse. Finding out that the patient recently had an arterial stick is strong indication that this is a pseudoaneurysm. The only treatment is surgical excision with vein grafting across the ensuing gap if the distal circulation is compromised, otherwise excision and ligation suffices.
Here is the extent of passive finger extension with the wrist flexed, and then the passive extension with the wrist passively extended to the limit.

What is the cause for these marked flexion contractures? As a hint, that yellow stuff used to be muscle. Now it is necrotic and scarred, certainly not supple or contractile.
This is a picture of Volkmann. Fortunately his beard style has fallen out of favor. Unfortunately the ischemic contracture he described is still far too common.

As a result of untreated compartment syndrome, the muscles, starved from their much-loved oxygen, die, leaving behind the gritty, yellow contracted and unyielding residue. At this point, removing the necrotic muscle precludes further contractures. Reconstruction will include tendon and possibly joint releases to restore passive motion and then tendon transfers or functioning muscle flaps to restore active flexion.
If you were a life insurance salesman, would you consider this person a good risk for a long and healthy life?
Those squiggly white lines running out his fingers are his arteries laden with calcium deposits, which are radio-opaque. If his digital arteries look like this, it is likely that his coronary and cerebral arteries look the same or worse. Narrowed, stiff vessels are likely to occlude sooner than later. In the fingers this leads to distal ischemia and necrosis. In the heart and brain, there are more severe consequences.
What sort of imaging study is this? Would you be happy if this was your hand?
This is an arteriogram. Several seconds ago, radio-opaque dye was injected into this patient’s brachial artery, and as it courses distally, rapidly sequenced x-rays are taken to demonstrate the pattern and patency first of the arterial tree, a few seconds later of the venous system. Here the ulnar artery and the ulnar side of the hand are not showing any flow. He has an obstruction somewhere in his ulnar artery. Also there is not good collateral circulation through the palmar arches from the radial side of his hand to the ulnar side. The ulnar side of his hand is markedly ischemic and needs help. Perhaps an embolectomy or thrombectomy across the occluded area would help, if not a vein graft spanning the diseased vessel segment would improve circulation.

By contrast, here is an arteriogram where there is too much blood on the ulnar side. This is caused by multiple arteriovenous malformations.