Overview of indications, preferred methods and technical tips for hand fractures from around the world

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Abstract
This article presents techniques used by six senior surgeons from different parts of the world. Our commentaries on treating hand fractures are included, together with the methods we use. While non-operative treatment is appropriate and effective for the majority of the hand fractures (including those many practitioners currently treat surgically), we describe how we try to manage difficult cases with less invasive surgical methods. We recommend simple, efficient, non-operative or less invasive operative methods for almost all fractures, except for some open or very complex injuries.

Keywords
Phalangeal fractures, metacarpal fractures, distal and proximal interphalangeal joint, carpometacarpal joint, percutaneous pinning, internal fixation

Introduction
In this article we report the techniques used by six senior surgeons from different parts of the world and commentaries on the management of various hand fractures in the form of questions and answers. While all agree that non-operative treatment is appropriate and effective for the majority of the hand fractures (including those many practitioners currently treat surgically), we describe how we try to manage difficult cases with less invasive surgical methods.

Techniques currently used around the world

1. In your practice, how many phalangeal and metacarpal fractures are treated with conservative treatment, with plating or screws, or with percutaneous pinning? What are the borderline cases for surgical treatment that you find hard to decide treatment?

Philip Blazar: I treat approximately 60% of phalangeal fractures and 70% of metacarpal fractures conservatively. I am very conservative with little finger metacarpal neck fractures. Plates and screws:

Phalangeal 10%, metacarpal 10%. Percutaneous fixation: Phalangeal 30%, metacarpal 20%.

Borderline cases: [1] Fractures that present acutely with excellent clinical alignment and good but subtly limited range of motion at presentation, with significant radiographic displacement (a few millimetres of shortening). Usually there is a proximal interphalangeal (PIP) extension lag. These will go on to union quickly, but a minority will not regain full motion. Technically it is very straightforward to reduce these closed and pin percutaneously. When the patient does not regain full motion with non-operative treatment,
the patient, the surgeon and everyone else look at the radiographs and can see how displaced the injury was and ask why it was not pinned. [2] Extra-articular proximal phalangeal fractures can be reduced closed, but have a risk of instability. It is hard within my practice/ geographic area to get patients to return three or four times within 3 weeks to ensure they do not lose reduction. For many of these, I end up pinning, but I suspect a high percentage could be managed non-operatively.

**Don Lalonde:** If patients have non-articular phalanx or metacarpal fractures that have a full range of movement with no scissoring, I do not operate. That includes long spiral fractures of metacarpals and phalanges with 2–3 mm of shortening. Surgery would not improve their outcome enough to justify it.

I almost never use plates on fingers. Too much scar is induced by their insertion. The scar over the plate and the plate itself generate too much bowstringing of overlying tendons. Cold intolerance of subcutaneous metal in the cold Canadian winter is a problem that leads to removal of many plates in the hand. Rigid fixation is not worth it. I prefer the functionally stable fixation that K-wires provide, and I can still allow early protected movement as described later in the question on less invasive surgical treatments. Most finger and metacarpal fractures are reduced and held with closed percutaneous K-wires. They are mostly buried and removed with local anaesthesia in the clinic.

**Carlos Martinez:** Conservative treatment: 75% of the metacarpal fractures. Our team surgically treats more phalangeal fractures, with nearly 65% non-operatively. Percutaneous pinning is used in 80% of the surgically treated fractures. Plates are used only in transverse fractures of the proximal phalanges. I use screws (mini screws 1.2 or 1.5 mm) only for displaced condylar fractures. Distal phalangeal fractures are usually treated by closed means.

**Michael Solomons:** In our unit, the vast majority of hand fractures are treated non-operatively. It does not mean that they are not treated. An active splinting and rehabilitation plan is crucial. Fewer than 5% of metacarpal fractures are treated operatively. Even substantial shortening and angulation in the sagittal plane is well tolerated. Function will mostly be 100%. My patients prefer a small bump of malunion than a surgical scar.

Cases that I find difficult to decide include extra- and intra-articular fractures at the base of the proximal phalanx. In the older patient, these fractures tend to go into extension, whereas they go into extension and ulnar deviation in the younger skeletally immature patients. Condylar fractures of the heads of the proximal phalanx and middle phalanx are unpredictable – some will displace, others will not. Knowing which ones to fix is tricky.

**Grey Giddins:** Well over 95% of phalangeal and metacarpal fractures are treated non-operatively. For those we treat operatively, most of them would be with closed reduction and K-wiring, or an application of a dynamic external fixator made of K-wires. We use plates and screws very infrequently.

Borderline cases that are difficult: (1) fourth and fifth carpometacarpal (CMC) joint injuries – minimal displacement and wide displacement are easy to decide treatment, but in between can be difficult. These fractures in computed tomography scans often look worse than in plain radiographs. [2] Shear fractures of the head of the metacarpal: unless very malaligned, I try not to operate. (3) Comminuted base of proximal phalangeal fractures: this is the fracture with the least reliable treatments. (4) Transverse base proximal phalangeal fractures: I usually use non-operative treatment, but the outcomes are not predictable with significant instances of stiffness and complex regional pain syndrome. If I operate I would use one or two longitudinal K-wires. (5) PIP joint fracture subluxations/Pilon fractures: if there is some good early movement, I try to avoid surgery. Judging which will do well is difficult.

**Jin Bo Tang:** I treat fewer than 20% of the digital or metacarpal fractures using surgery. Of these 20%, 80–90% are treated percutaneously. Plating has not been used in my recent memory; screws are used for some large oblique fractures or those close to joints. I believe these treated with screws could be treated with K-wires, but I feel screws are more stable. Fine cannulated screws are better than conventional screws.

Recently I have not treated multiple metacarpal fractures, so I have had no chance to plate these cases. Two decades ago, I treated open multiple metacarpal fractures with multiple K-wires, which were quite efficient. I believe that, although plating can be used for multiple fractures of the metacarpals, these fractures can be treated with K-wires. I think that there is almost nowhere in the hand – phalanges and metacarpals –where a plate has to be used. No matter how low the profile is, plating needs stripping of periosteum and a large skin incision. Why not use a less invasive method?

2. What are the absolute indications for open reduction and plates or screw fixation for phalangeal and metacarpal fractures?

**Grey Giddins:** Phalangeal fractures: the main indication would be a severe open injury, this might even include an amputation or revascularization. Then I
would want absolute stability to achieve early mobilization of the injured tendons. If there were multiple injured fingers, I may well be more inclined to think of open reduction and internal fixation to gain early mobilization. As these are, however, often associated with crush injuries, soft tissue viability can be precarious and then sometimes I will simply use K-wires, accepting there will be some stiffness, but these are severe injuries.

Metacarpal fractures: multiple open metacarpal fractures are better treated with dorsal plates and screws. For me, this is about the only absolute indication for open reduction and plate or screw fixation.

Relative indications include: irreducible transverse metacarpal fractures, hamate fractures where there is a large split where sometimes screw fixation is the optimal way to gain stability, crush fractures – the diaphysis typically of the thumb proximal phalanx where there is a lot of soft tissue and bone injury.

For those fractures with relative indications, I often simply stabilize these with a K-wire or dynamic external fixator for perhaps 1 week to 10 days, and then plate the fracture once the soft tissues have settled, supplemented with bone grafting. The fractures hardest to treat are comminuted fractures at the proximal phalangeal base. I am reluctant to plate them, as this is often not good, with a lot of adherence of the plates. There is no good K-wire solution and often we use some form of dynamic traction (such as banjo traction), but I do not think this is particularly good treatment.

Jin Bo Tang: The literature is not clear about absolute indications for plating or screw fixation in the hand. We often read a list of absolute indications in textbooks, which are just recommendations. K-wire fixations – most of the time, requiring multiple K-wires, at different directions – can be used for any of the complex fractures instead. In some instances, such as open multiple metacarpal fractures, screws and plating produce more stable fixation (though not necessarily better outcomes or less non-union cases). I would use plates and screws in multiple metacarpal fractures, but I will not hesitate to use multiple K-wires if the soft tissues are damaged and the fractures need internal fixation in a less time-consuming way. Combined metacarpal and proximal phalangeal fractures are a good indication for plating. I would plate the metacarpal and pin the proximal phalanx, to allow limited early motion of the hand.

Don Lalonde: *Open reduction and plate or screw fixation is absolute for multiple unstable metacarpals.* If I have to open a phalanx or metacarpal fracture, I will prefer screws to K-wires because the fixation is more rigid. I do not like plate fixation in phalanges at all. Metacarpals are more forgiving for plate fixation. I only use plate fixation in hand fractures if I cannot get functionally stable fixation with K-wires or screws. Functionally stable fixation is enough fixation that the fracture will heal in a good position of function. It is more important than rigid plate fixation, which can lead to too much surgery and scarring.

Philip Blazar: (1) *Multiple metacarpal or proximal phalanx fractures in one patient.* (2) Combined injuries including tendon injuries where rigid fixation allows early rehabilitation. (3) *Significant bone loss.*

Michael Solomons: Any rotation deformity will not be tolerated by the patient and will be difficult to hold with conservative means. We prefer interfragmentary fixation where possible. Ultimately the absolute indication for open reduction internal fixation is failed conservative treatment.

3. Please comment on less invasive surgical treatment (such as percutaneous pinning and dynamic traction devices)

Philip Blazar: (1) *Most single bone fractures needing surgery can be fixed with percutaneous pinning.* This usually allows early initiation of hand motion, although not as early as with plates and screws, but in my hands the incidence of needing secondary surgery (hardware removal, tenolysis and capsulectomy) is much lower with pinning, and if needed after pinning it is much easier. (2) I reserve dynamic traction for complex PIP joint injuries. Hemi-hamate osteochondral grafts have made a proportion of these injuries (volar fractures with multiple fragments) easier to manage. (3) I do use ‘metacarpal nails’ a few times a year, exclusively for metacarpal shaft fractures, typically transverse, or short oblique fractures, but I have used them for multiple metacarpal fractures. They achieve reduction and fixation that is solid enough for hand motion with minimal soft tissue dissection. I remove the majority of these in the operating room [one downside compared with percutaneous pinning].

Jin Bo Tang: I find dynamic traction is good for finger PIP joints and thumb interphalangeal (IP) joint injuries. I try to avoid open reduction and internal fixation for these intra-articular fractures and use dynamic traction, especially if there are multiple, often small, fracture fragments. Because the thumb is separated
widely from the fingers, the traction device is particularly well tolerated.

For single large intra-articular fractures of the thumb IP or metacarpal joints, I use percutaneous pinning; percutaneous cannulated screws can work well if the fragment is over 1/3 of the articular surface. If the fragment is small, I recommend a K-wire. Open reduction of phalangeal fractures in the thumb is usually not necessary and can be very difficult.

Carlos Martinez: We often use dynamic traction devices for PIP joint injuries. We manufacture our own devices with pins and elastic bands, and leave them prepared for the surgeons on duty. The surgery is done under local anaesthesia.

Michael Solomons: Percutaneous pinning is a necessary evil. I recommend inserting the wire(s) through the unstable fragment first and then retrograde into the stable fragment. I pull these wires back so that they are not embedded in or near the collateral ligaments. They are not good for diaphyseal fractures, but are very useful for metaphyseal fractures that will be sticky after 2 to 3 weeks. The wires can then be removed avoiding sepsis.

Grey Giddins: Percutaneous pinning: find this a very useful technique that I have used widely for many years. I have, however, tended to use it less as I have become even more conservative.

Dynamic traction devices: I have a bias having described a dynamic traction device (Hynes and Giddins, 2001) made up of K-wires, which I use for Pilon fractures in particular, typically at the PIP joints, but also at the thumb IP and metacarpal joints. It can also be used for fracture subluxations and distal interphalangeal (DIP) joint injuries. I find it a very valuable technique for intra-articular fractures with comminution allowing early mobilization with joint distraction.

Don Lalonde: Most K-wires in fingers can be removed at 10–30 days. Surgeons should not wait for radiological healing as it is a bad indicator in fingers. Clinical healing is more important, i.e. when it is no longer tender.

Healing of fractures will always take longer if treated open due to reduced blood supply from periosteal stripping. I always try to reduce finger fractures closed and held with percutaneous K-wires. In addition, every time you open a fracture, the space created fills with blood, which turns to either bone or scar. It will take the patient months to clear out that debris spontaneously. The new bone and scar impede movement until they are gone.

Early protected movement following K-wiring is just as important as early protected movement in flexor tendon repair: a stiff finger is a useless finger. I start early protected movement of IP and metacarpal joints 3–5 days after immobilization once patients are off all pain medicine. They are only allowed to move a little and only if it does not hurt. This is pain-guided hand therapy. If they avoid painful movement, they will avoid pin track infection and loss of reduction. The finger is immobilized when not out hourly, as after flexor tendon repair. They can move the injured fingers, but they cannot use the injured fingers.

4. Any tips or unique methods for internal fixation of displaced intra-articular fractures of the PIP joint?

Philip Blazar: These injuries continue to be ones where I sometimes leave the operating room asking: why did I open that fracture?, but ...

Cerclage wire: on occasion I will use it around the base of the middle phalanx if there is comminution with an intact dorsal cortex, although for many of these fractures I now use a hemi-hamate autograft. Via a volar approach, a 24-gauge steel wire is passed around the comminuted base of the middle phalanx and the wire is crimped away from the flexor or extensor tendons. A small K-wire placed across larger fragments and brought out dorsally can also add stability.

Volar fracture dislocations with avulsion of the central slip: I have had some success using small K-wires and suture anchors placed distal to the fracture, with the suture passed over the fracture fragments in a horizontal mattress and passed through the central slip insertion.

Don Lalonde: I always try to reduce the fracture closed with fine (1.1 or 1.4 mm) K-wires. Percutaneous towel clips or bone clamps with sharp tips are used to hold the fracture reduced while inserting the K-wires. I use dorsal blocking K-wires for PIP or DIP joint dorsal subluxations bones with early protected movement. I use distraction splinting with the Schenck banjo splint and ligamentotaxis for intra-articular comminuted fractures of the PIP or metacarpal joints (Figure 1 and 2).

Grey Giddins: Condylar fractures: I typically treat these with manipulation and closed K-wiring. If I did open the fracture, I may well only use one screw as described by David Shewring et al. (2015). One tip is to pass a 1.1 mm K-wire across the middle phalanx (distal to the fracture) and bend it to apply continuous
traction with a needle holder that keeps the fingers outside the X-ray beam.

Base of middle phalanx fractures: in my practice there is no indication for internal fixation. I would use a dorsal blocking K-wire for fracture subluxations when there is at least 50% of the base of the proximal phalanx remaining and there will be some useful early gliding. Otherwise I would use a dynamic external fixator.

Michael Solomons: My indications for surgery are marked dorsal subluxation and the dorsal V sign. When they try to flex these, joints hinge rather than glide. If they can be flexed gently and the joint becomes congruent, then an extension blocking splint is used. If the joint cannot be flexed, then open reduction internal fixation is offered. We try, where possible, to do a volar approach and screw fixation (occasionally cerclage wiring). If it really is unfixable, then we have had good results with the hemi-hamate operation. I have tried dynamic traction techniques over the years with, at best, average results.

Carlos Martinez: We have tried to decrease the radiation exposure during placement of dynamic external fixator in the PIP joint. Under local anaesthetic, we mark the skin, then decide the site of entry, route and site of exit of each of the two pins and insert the pins under fluoroscopic guidance.

5. What are the allowable angulation for metacarpal neck fractures and your indications and methods of treating neck fractures?

Don Lalonde: I will only speak about fifth metacarpal neck fractures. The answer is 40° (Hoffmeister et al., 2008). They showed that fifth metacarpal neck fractures can be immobilized with metacarpal joint extension with Level II evidence. In my practice, I can hold the reduction in more boxer’s fractures without pinning. I almost never internally fixate these. Most only get a splint and no internal fixation. If I do anything at all other than a splint, I usually just pin them closed with K-wires.

Jin Bo Tang: I believe that plaster fixation in the intrinsic plus position is often over-used for the metacarpal fracture. Flexion of the metacarpal joint to 50° to 60° is usually sufficient to prevent any metacarpal joint stiffness. Why use 90°? My patients are very happy that I have moved to 50–60° metacarpal joint flexion.

I allow 30–40° angulation of the metacarpal neck in the ring or little fingers and 30° for the index and middle fingers. The ages and profession of the patients add weight in deciding the treatment. Correction is mostly cosmetic; angulation does not affect grip strength and daily hand function. However, scissoring is a more serious concern. Rotatory deformity of about 20–30° of the metacarpal head causes a great problem in finger flexion and grip, which requires correction.

Grey Giddins: For the vast majority of these injuries I think there is no indication for surgery, thus I simply organize mobilization. As shown in the randomized control study published in this issue (Sletten et al., 2015), there is no obvious benefit from K-wiring a ring or little finger metacarpal fracture from 30–50° of angulation. If it is very angulated, around 70°, I would perform a manipulation and attempt to reduce the fracture in part in plaster. Although the evidence suggests that this does not particularly work, in my
experience it can reduce the angulation from 70° to 50°. This then puts it in the zone where non-operative treatment works well. For the index or middle fingers, I aim to reduce closed to within 20°, or else I would manipulate and K-wire.

Those fractures that are a little more proximal in the neck, i.e. distal shaft, can sometimes give a significant cosmetic abnormality. Normally they can be held adequately with a manipulation in the outpatient clinic and holding in plaster, but just occasionally they require K-wiring, such as with Bouquet wiring or K-wires, from the little to the ring finger.

Carlos Martinez: Metacarpal neck fractures: although angular deformity has not been proven to lead to loss of function, we use intramedullary pinning in the fractures with more than 25° of angular deformity. We are using bioresorbable implants for patients under 12 years old. In all cases a thermoplastic functional cast or plastic splint is indicated.

Michael Solomons: Little and ring fingers: I accept almost any angulation as long as there is bony contact between the fracture ends. Once bony contact is lost, then the mechanical advantage of the joint is lost and the patient will have a substantial extensor lag and pseudo-clawing. They all have temporary extensor lag on initial presentation, so this is not an indication for surgery. If surgery is required, then I prefer plate fixation with a volar bone graft. Index and middle fingers: I accept no more than 20° as the lack of motion at the index and middle CMC joint does not allow for any adaptation.

Philip Blazar: Small finger metacarpal neck fractures: non-operation with early motion exercise unless there is pseudo-clawing or rotational deformity. When I do operate, I mostly use closed reduction and percutaneous pinning.

6. Is complete restoration of integrity of articular surface of the second to fifth CMC joint after intra-articular fracture at these joints necessary? Do you aim to restore or can you restore?

Philip Blazar: No. My aim is overall alignment and length. I do not open the index of middle finger CMC joints for intra-articular deformity unless a fragment blocks the extra-articular reduction. The ring and little fingers have significantly more mobility, so there is significantly more potential for symptomatic degenerative change. However, degenerative joint disease at these joints is so well tolerated that unless there is a difficulty reducing the extra-articular relationship closed or a sizable (>2 mm) step-off, I will treat with percutaneous pinning.

Grey Giddins: I think complete restoration of the anatomy is very difficult. The index and middle finger metacarpals are rarely affected. It would be even rarer for me to consider surgery on the basis that there is so little movement there, and the likely worst outcome would be a painful degenerate joint that could be easily treated with an arthrodesis. Typically, therefore, at most I would perform manipulation and K-wiring, holding the index metacarpal out to length relative to the middle finger metacarpal and trust that local ligamentous pull would lead to an adequate correction of the CMC joint.

In the ring and little finger metacarpals there is often some dorsal subluxation, there may be a coronal split in the hamate. Usually these will reduce with traction and then hold with K-wires. Typically I would place a transverse 1.1 or 1.6 mm K-wire from the mid-shaft of the little finger to the ring finger, and even to the middle finger, metacarpal to hold them out to length. I then use one or two 1.1 mm K-wires near the base of the metacarpals into the distal carpal row to hold the reduction. A clear split in the hamate might be an indication for open reduction. The ulnar two CMC joints tolerate some incongruence reasonably well as long as there is no significant subluxation. Thus, they can mostly be treated successfully with closed manipulation and K-wiring.

Don Lalonde: I will percutaneously closed K-wire dislocated ulnar metacarpal bases pulled out of joint by the extensor carpi ulnaris. I almost never have to open them, and I frequently accept minor joint irregularities.

I do not believe that complete restoration of integrity of the articular surface of the index to little finger CMC joints after intra-articular fracture is necessary. I have been in practice for 30 years and I cannot recall one patient coming to me complaining about CMC joint pain after intra-articular fractures of the base of the metacarpals.

Michael Solomons: We have seen great results with missed intra-articular fractures and fracture dislocations, especially the little finger. Despite this, we still aim for anatomic reconstruction of the dorsal fracture dislocations where the hamate is fractured in the coronal plane. The Pilon type axial loading injuries are left alone.

Carlos Martinez: Percutaneous pinning from the little finger metacarpal base to the hamate or the base of the ring finger metacarpal stabilizes the dislocation. If
the fragment is large enough, open reduction and fixation with a mini screw can be performed. In comminuted fractures, I use closed reduction and fixation with K-wires from the little and ring finger metacarpals to the middle finger metacarpal under traction. Unlike the first CMC joint, a displaced or unreduced fracture of the little finger metacarpal base may mould, and healing may proceed allowing a reasonably functional joint.

Jin Bo Tang: Although I try to restore the integrity of all the CMC joint surfaces, this is not a major goal. I only attempt to reduce the fracture to an acceptable, not a ‘perfect’, joint surface contour. I do not think it matters greatly. I do not see the need of open reduction. Two K-wires are commonly used to keep reduction. The K-wires usually go into hamate or capitate unless an anatomic or near anatomic reduction opening the joint to achieve anatomic reduction unless an anatomic or near anatomic reduction (<1 mm step-off or gap) can be achieved closed. The one caveat to this is the very comminuted fractures of the thumb base [Rolando type], particularly if there are multiple fragments visible. I will treat with sustained traction and attempts at percutaneous reduction techniques, as I have been able to open the thumb CMC joint to restore articular anatomy stably enough to allow early mobilization.

Jin Bo Tang: I think the little finger CMC joint is very different from the thumb CMC joint. I have never seen symptomatic little finger CMC arthritis, although radiographic incongruity of the little finger CMC joint is not uncommon. Arthritis of the little finger CMC joint is not a clinical concern. Open reduction of the little finger CMC joint fracture for the purpose of preventing arthritis is wrong.

Grey Giddins: I think base of thumb fractures are less tolerant of incongruency, so I have a lower threshold for surgery. Many Bennett’s fractures can be treated non-operatively (see next section). For Rolando type fractures, I generally try to avoid open surgery with traction via two 1.6 mm K-wires from the thumb metacarpal to the index finger metacarpal, sometimes supplemented by one or two 1.1 mm basal K-wires and rarely some bone graft. I usually keep this construct for around 5 weeks.

8. What are the often used methods for the Bennett’s fracture in your practice?

Don Lalonde: I almost never have to open a pure Bennett fracture where the fracture is in only two pieces with the larger thumb metacarpal fragment subluxated off the trapezium. I can easily reduce and hold with a percutaneous K-wire. The key tips are: (1) distraction; (2) pressing on the metacarpal base with my thumb to push it back into joint; and most importantly (3) pronation of the thumb base on the trapezium. The last manoeuvre uses the dorsal ligament complex to reduce the joint anatomically. The K-wires are left in for 6 weeks.

Jin Bo Tang: Typically I use two 1.8 mm K-wires: one K-wire goes through the trapezium lateral to the avulsed fragment; another goes from the middle of the thumb metacarpal to the shaft of the index finger metacarpal. The fragment can be easily reduced, as Dr Don Lalonde describes. The thumb is pronated and abducted sufficiently when the second K-wire is inserted. I rarely need to open this fracture.
Grey Giddins: Typically I will undertake a manipulation and K-wiring of the fracture. I have previously tried to K-wire across the fracture site. I think the key is not to K-wire across the fracture, but rather to reduce the main part of the shaft of the metacarpal onto the trapezium. I think that this needs to be done with quite a peripheral wire as it is easy to put the wire through the fracture site and hold it displaced. Having recently reviewed the literature, there appears to be no evidence that non-operative treatments are worse than operative treatments, provided the reduction is adequate. So I am also starting to perform manipulation and holding these with plaster. We have developed a modified Bennett’s plaster in Bath, holding the thumb metacarpal joint flexed, initially in plaster, and then putting the rest of the plaster on to make sure there is no metacarpal joint hyperextension. The key is adequate reduction of the base of the thumb metacarpal. There should be a step of no more than 1 mm. Provided this is achieved and held for 6 weeks, then there should be a good outcome and surgery should not be needed.

Philip Blazar: The vast majority of these are treated with closed reduction and percutaneous pinning. Pin fixation usually includes the main thumb metacarpal fragment to the trapezium. In cases of larger volar fragments, pin fixation or percutaneous screw fixation is used. I reserve open reduction and more rigid fixation (multiple screws, 1.5 mm plate and screws or combined screws and K-wires) for cases where earlier return of function is achievable (larger fragments) and clinically indicated (e.g. a high level athlete where a few additional weeks away from sport is a hardship).

Carlos Martinez: Traction, closed reduction and pinning. The pinning we use is one K-wire across the fracture and another K-wire across the joint indirectly stabilizing the fracture. With small deep fracture fragments where we cannot put the K-wire across the fracture, we use two K-wires across the joint. For large fracture fragments >1/3 of the base of the metacarpal, we prefer screw fixation via a volar approach.

Michael Solomons: Under screening, the joint is manipulated as described by Don Lalonde. If a perfect reduction can be achieved on all views, K-wires are inserted. These are placed with no real intent on spearing the small fracture fragment. One K-wire is inserted into the carpus and another is passed into the index finger metacarpal. No intra-articular step is accepted. If there is a step, we perform internal fixation with a lag screw via the volar radial (Wagner) approach.

9. Any advices on dealing with chronic mallet fingers, malunion of the fractures at the proximal phalangeal shaft and malunion of the metacarpal neck fractures?

Grey Giddins: Chronic mallet fractures: it is rare for these to need treatment in my experience. Were they to need treatment, this would probably be for a significant extensor lag and I would attempt some form of osteotomy and advancement of the bony fragment, but that is rare. Correction of the DIP joint usually resolves the swan-neck deformity so I would treat the DIP joint first and only treat the swan-neck deformity if it persisted. If significant DIP joint subluxation is present, that is probably not going to be amenable to surgery other than a fusion for pain.

Proximal phalangeal shaft and metacarpal neck fractures: if these are significantly mal-united, I would undertake an percutaneous technique, perforating the bone at the malunion site with multiple passes of K-wire and performing a closed osteotomy, i.e. fracturing the bone in a low energy manner. I reduce the deformity and then stabilize it with one or more 1.1 mm K-wires. I hold the digit in plaster for 4–5 weeks, remove the K-wire(s) and mobilize from there. I have had one delayed union and usually good correction and minimal morbidity. This technique does not allow for the treatment of adherent tendons, etc., at the same point, but I prefer to do this in a staged rather than a single procedure.

Philip Blazar: Chronic mallet fingers: I have found tenodermodesis to be effective in adolescents. I have not used it in adults. I discourage adults from pursuing surgery for chronic mallet fingers. When patients develop a swan-neck deformity I use a number of treatments. Figure of eight splints ('Silver ring') are successful for a large percentage, but are rarely accepted for long-term use in my practice by men. In older patients, particularly with any degree of osteoarthritis at the DIP joint, I prefer DIP joint arthrodesis. In adults without osteoarthritic changes, I have used both flexor digitorum superficialis tenodesis and spiral oblique retinacular ligament reconstruction for swan-necking. In my experience the latter operation corrects both joints, while the former only corrects the PIP joint, but it is also a more extensive undertaking, including harvesting a tendon graft and more extensive dissection of the digit.

Don Lalonde: Malunions that are even 3 months old can frequently be reopened with careful use of a periosteal elevator and fine, gentle osteotome dissection. Care is taken, like when archaeologists dig dinosaur
bones out of hard clay. Rotation osteotomies are rare in my practice.

Chronic mallet fractures with volar subluxation of the distal phalanx base can frequently be reduced under local anaesthesia by the patient pressing on the base with a force driving the base back up dorsally for several minutes. If the surgeon is patient, the collateral ligaments will relax and the subluxated bone will go back into place, even if it has been out of place several months. It can then be K-wired in a reduced position for 8 weeks.

10. Please describe one or two technical tips that you find very useful or deserve more attention

Philip Blazar: Two technical tips from earlier are worth additional comments. (1) ‘Metacarpal nails’ for metacarpal fractures. They are inexpensive and can address many metacarpal shaft fractures with less soft tissue dissection, less metal that can potentially irritate tendons and still achieve excellent stability allowing early aggressive motion. (2) Many problematic fractures in the hand are small articular fragments with important soft tissue attachments (e.g. central slip). These fragments will not accept a screw without fragmenting and K-wires may not give adequate stability to allow early motion. The addition of a composite fracture fixation using a narrow wire loop or a suture anchor can add significant stability allowing for earlier motion without risking fragmenting the piece. I also find the Accutwist (Acumed, Milford, Ohio, USA) (I have no interest or conflict) implant helpful and quite forgiving for small joint arthrodeses and some similar fracture fragments. The implant is a headless screw with a tapered variable pitch thread, but the diameter is more akin to a K-wire than a screw or a cannulated screw. The implant size makes technical placement very forgiving. For fragments that require compression, but are likewise too small to accept a 1.5 mm screw, they can be helpful.

Lastly, for surgeons who are in training or less experienced with interfragmentary screws in the hand, I suggest placing these without overdrilling the near cortex; these interfragmentary, non-lag screws are technically more straightforward and I suspect mechanically equivalent or nearly so.

Grey Giddins: When K-wiring, pass the K-wire into the first fragment, then complete/confirm the reduction and then pass into the far cortex, but not through it. By not penetrating the far cortex the K-wire will not migrate in, so is more stable causing fewer complications.

When wiring bony mallet injuries, if you pass a K-wire along the distal phalanx from the tip of the finger it often goes through the fracture site, reducing the chance of a good reduction. I pass the wire from proximal to the head of the middle phalanx obliquely across the DIP joint into the distal volar fragment, reducing this risk.

Don Lalonde: Get patients to not move or use their hand for 2–3 days after any kind of hand fracture surgery. They should keep it elevated and immobile until: (1) internal bleeding is no longer likely; (2) swelling is gone; and (3) they are off all anti-pain medicine so they know what hurts. Collagen formation does not start until day 3, so there is no need to move the fingers before then. Movement starting the day of surgery, even with rigid fixation, will only generate bleeding into the wound. That blood occupies space. It takes the white cells days to remove that unnecessary debris.

For the same reasons as in the previous paragraph, fracture surgery is best performed with lidocaine and epinephrine injection into the fingers and hand before the surgery, and no tourniquet. This will prevent bleeding into the wound generated by ‘let down’ bleeding when the tourniquet is released. This will also permit the surgery to be performed wide awake. The cooperative patient can demonstrate to the surgeon the stability of his bone fixation, impingement of soft tissues on K-wires, etc. This enables the surgeon to make intraoperative adjustments to the bone fixation or soft tissues before closing the skin.

Michael Solomons: Choose your patients very carefully. Hand surgeons around the world spend more time removing plates and doing tenolysis and joint releases than they do surgery for malunion. Proximal phalangeal fractures can be reduced and held with a dorsal plaster applied to hold the metacarpal joint at 90°. Do not apply a dorsal splint with the metacarpal joints flexed at 90° for angulated metacarpal fracture. The mechanism of injury and muscle forces acting on the fracture will cause the distal fragment to flex. This is exacerbated by any dorsal splint and metacarpal joint flexion. Rather apply a volar splint up to the distal palmar crease.

Jin Bo Tang: Overuse of open surgery is a problem for many patients worldwide with phalangeal or metacarpal fractures. In practice, a fracture treated with either a simpler method, or an (unnecessary) more complex method, may end with similar function. The patients do not know they have been over-treated and are often more grateful than they should be. Understanding how to use simple and efficient treatment is a key.
After a K-wire is inserted into one fragment, it is the time to use the K-wire to help align the fracture fragments. The reduction is achieved if necessary using the K-wire before or at the time of advancing the wire. Use adjacent healthy bones (metacarpals, phalanges or carpal bones) to help keep reduction or anchor wires. Multiple K-wires are rarely more damaging than open reduction. K-wires can be placed creatively while guided by anatomy and mechanical consideration.

Concluding remarks

We doubt whether many patients with phalangeal or metacarpal fractures treated surgically do better than if they had been treated conservatively. In particular, all believe that plating is rarely or only occasionally needed for phalangeal fractures.

As acute hand fractures are common and the treatment is evolving towards less invasive and cost-efficient approaches, we recommend the readers use simple, efficient, non-operative or less invasive operative methods for most fractures. Open reduction and internal fixation is mostly only required in a small number of complex or open injuries.

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References


