Focus On
Distal radius fracture: current concepts and management

Up until a few decades ago, distal radius fractures were often casually regarded as ‘Colles’ fractures’. The treatment was mainly manipulation and casting, since the generally accepted concept proposed by Abraham Colles in 1814, was that although these fractures would heal with deformity, the functional deficit would be acceptable. With better understanding of the various fracture types, classifications such as Frykman, Melone and AO were developed. There was a need for a better method of treatment after careful study of the individual fracture pattern. Moreover, the need for better outcomes in these fractures has frequently been revisited as newer methods of treatment have been developed. Fracture union is no longer the only goal, as the restoration of normal anatomy with early functional recovery, as well as resultant full and painless motion of the wrist, take over as the ultimate goals of treatment.

Factors affecting choice of management

Patient-related

- **Age**
  - Patients aged > 65 years were more likely to suffer from secondary displacement.
  - Risk of failure to maintain reduction was four times higher in patients > 60 years.
  - Independent predictor of late instability and malunion.
  - However, older patients are also more tolerant of radiological malalignment, and functional outcome may not correlate with restoration of anatomy.
- **Osteoporosis**
- **Work-related injuries**
  - Injury compensation is a predictor of pain and disability.
  - Less likely to return to work.

Fracture characteristics

Some fracture patterns are more likely to result in significant deformities leading to worse functional outcomes. Predictors of instability and redisplacement after manipulation include:

- Initial displacement (lateral displacement > 1 cm or radial shortening > 5 mm)
- Presence of metaphyseal comminution
- Intra-articular fractures with articular incongruity (step off > 2 mm)
- Associated distal ulnar fractures

Non-operative treatment (closed reduction and casting)

**Indications**

- Undisplaced fractures
- Well reduced stable fractures
- Old age, low functional demand

**Pitfalls**

- Cumbersome cast or splint
- Adjacent joint stiffness
- Loss of reduction more common than surgically treated fractures
- Median nerve neuropathies
- Cast impingement and compartment syndrome

Closed reduction and casting can be performed in many cases when the fractures are stable after reduction or are minimally displaced. The reduction is based on the principle of ligamentotaxis. The deformity is exaggerated, the mechanism of injury is reversed and a plaster cast is applied to keep the fracture in a reduced position using a three-point fixation principle. No control can be expected for intra-articular fragments without any capsular attachment. The subsequent decision for surgical intervention is based on the surgeon’s analysis of the quality of the closed reduction and the likelihood of redisplacement.

There is a general consensus that in young and functional patients, more efforts should be placed into restoring the anatomy of the wrist joint and allowing early motion. The tolerance to fracture displacement in casting is therefore less. For elderly patients, recent prospective randomised studies have shown that non-operative treatment may yield better than expected functional results. In the long-term, malunion and radiological arthritis do not essentially mean more significant symptoms.

Overall, there is not enough evidence to conclude whether cast immobilisation or surgical fixation provide a better functional outcome. Currently a randomised multicentre clinical trial is being conducted in Germany which may give us more evidence.

Surgical treatment

The decision to adopt surgical treatment often depends on timely identification of those at risk of having poor outcome after closed reduction and casting. Some insights can be gained from patient factors and fracture characteristics mentioned above. A CT scan is invaluable in assessing the configuration of intra-articular fractures.

Due to a lack of universal consensus, it is difficult to outline a general guideline in treating all distal radius fractures. Various methods of surgical treatment are described and many randomised trials can be found throughout medical literature. The best treatment method should restore and maintain anatomy, allow early mobilisation and have minimal risk of...
complication. Each surgical method has pros and cons and the surgeon should choose the appropriate method for individual fractures according to one's surgical expertise.

**Plate fixation**

**Indications**
- Unstable fractures
- Intra-articular fractures
- Fractures irreducible by closed means
- Delayed fixation
- Preference for earlier mobilisation

**Pitfalls**
- Uninsightly scar
- Tendon rupture (flexor or extensor)
- Some patients may require implant removal
- Implant cost
- Technically more difficult than other surgical methods

There is an increasing popularity towards open reduction and plate fixation. After restoring the anatomy of the articular surface, a sufficiently stable construct also allows for early mobilisation.

Angular stable ‘locking implants’ were first introduced a decade ago. They achieved significantly improved mechanical stability in fracture fixation when compared with non-locking implants.\(^{28}\) A few randomised control trials since then have shown that open reduction and internal fixation with locking implants were usually superior to both external fixation\(^{26,28}\) and percutaneous pinning.\(^{29,30}\) with regard to radiological results, early functional results, and complication rates. Many of the studies, however, had difficulty proving advantages in long-term outcome after one year. It is worth noting that studies using older generation non-locking implants\(^{31-34}\) have not produced similarly superior results when compared with external fixation, pinning or casting.

A volar approach is usually recommended for plating in most fracture types. There is better soft-tissue coverage and less tendon irritation. Jakubietz et al\(^{35}\) have shown that routine volar plating was associated with significantly better range of motion, grip strength and pain, when compared with routine dorsal plating. Despite being technically easier, the surgeon must still be familiar with the proper surgical technique of volar plating, and be mindful of potential complications that may arise\(^{36}:\)
- Extensor tendon injury or rupture
- Flexor tendon irritation or rupture
- Carpal tunnel syndrome
- Complex regional pain syndrome
- Loss of reduction
- Hardware failure

A dorsal approach and dorsal plate fixation may be required in some cases when a volar approach alone cannot achieve anatomical articular reduction and stable fixation. A careful CT evaluation of the fracture pattern before surgery is therefore recommended to determine whether a dorsal approach would be necessary. Some surgeons recommend routine removal of dorsal implants due to a higher rate of tendon attrition rupture\(^{37}\) and a more significant improvement in function after dorsal implant removal relative to volar implant removal.

**External fixation**

**Indications**
- Unstable fractures
- Highly comminuted intra-articular fractures
- Poor soft-tissue conditions including open fractures
- Adjunct to internal fixation or pinning

**Pitfalls**
- Cumbersome external frame compared with internal fixation
- Pin-tract infections (14%)
- Tendons and sensory radial nerve injury

The fracture is immobilised for six to eight weeks with the fixator depending on fracture pattern and healing. Different techniques of external fixation are described below.

A bridging external fixator device spanning the wrist joint is usually placed dorsally or radially with threaded pins inserted into the metacarpal bone and the shaft of radius. The wrist joint and the fracture site are immobilised. Fracture reduction is maintained by the principle of ligamentotaxis. However, over distraction should be avoided to prevent excessive pain and finger stiffness with resultant poor functional results.

A non-bridging external fixator can also be used with pins placed into a relatively sizable distal radius fragment. This allows for more direct fixation without ligamentotaxis. Early mobilisation of the wrist joint is also possible. Studies have shown improved radiological outcome but mixed clinical outcomes,\(^{38,39}\) a systematic review\(^{40}\) of nine trials with 510 patients found no robust evidence to conclude that it is superior to the bridging method.

Dynamic hinged external fixation allows early motion of the wrist joint. It is technically demanding and not widely available. Studies have shown that patients can regain range of motion early,\(^{41,42}\) but at increased risk of pin-tract infections. There was no significant difference in eventual clinical outcome.

Randomised clinical trials\(^{31,43}\) and a large systematic review\(^{44}\) comparing all methods of external fixation versus conservative treatment concluded that external fixation yielded better radiological results. There was some suggestion of improved clinical outcomes, and less secondary surgery. External fixation was also associated with higher rate of minor complications but similar rate of serious complications such as reflex sympathetic dystrophy.

**Closed reduction with percutaneous pinning**

**Indications**
- Unstable fractures without significant comminution

**Pitfalls**
- Additional casting or external fixator often needed
- Pin-tract infections
- Tendon and superficial radial nerve impalement
- Loss of reduction more likely when compared with plating

Kirschner wires are percutaneous placed to stabilise fracture fragments before the wrist is further immobilised with a cast or external fixator. This permits direct fixation of major fragments in addition to ligamentotaxis. Surgical incision is minimal and implants are economical. The pins are removed percutaneously
after a few weeks when healing becomes evident.

Randomised trials and a systematic review showed that percutaneous pinning across fractures was associated with improved anatomical outcome and minor complications compared with casting. The improved radiological outcomes did not necessarily translate to improved functional outcomes.

Extra-focal pinning means that Kirchner wires are plated through the fracture site, directly stabilising the fragments. This differs from intra-focal pinning where Kirschner wires are placed into the fracture site and the fragments are stabilised by a combination of mechanical block and soft-tissue pull.

Metal pins are recommended, as biodegradable pins were shown to be associated with more complications. Pin-tract infection is usually self-limiting. This can be reduced from 20% to 4% according to Hargreaves et al., by burying pins within the skin. However this means that further surgery will be required for removal.

**Adjunctive measures**

Surgeons may elect to use bone graft or artificial bone substitutes during surgical treatment. This addresses significant bone defects resulting from fracture impaction, delayed surgical treatment and osteoporosis. Filling the bone defect can improve the rate of union, provide short term mechanical support and prevent loss of fixation.

While complications at the fracture site are rare, routine use of bone graft or substitutes is unnecessary. Artificial bone substitutes are expensive and significant donor site morbidity occasionally results from autologous bone graft harvesting. There was mixed outcome from clinical studies regarding routine use of these methods.

Most reported improved radiological outcome but there has been no significant evidence to show that the functional outcome is also improved.

Fracture healing may be slightly speeded up by alternating electric current stimulation and teriparatide injection. These effects are noted to be small and the results have yet to be confirmed by larger trials.

**Rehabilitative exercise and follow-up**

Rehabilitative exercise of the wrist is mandatory as with treatment of other fractures. Studies have shown favourable outcomes when a systematic regimen of exercises are routinely introduced during the early stage of treatment. Alternatively, when instructed a detailed and specific self-exercise regimen by the surgeon, compliant patients may also expect results comparable to formal rehabilitative training. Early mobilisation goes hand in hand with stable fixation. The wrist joint can tolerate immediate range of motion exercise after internal fixation. Strengthening exercises are started when fracture union becomes more solid. Loss of reduction usually occurs within the first month, and early follow-ups with radiological assessment are necessary to monitor progress and detect complications.

**Assessment of outcomes**

The treatment outcomes of distal radius fractures have all along been evaluated by objective measurements such as grip strength and motion as well as radiographic parameters. Recently, there is an increasing demand to adopt patients’ subjective evaluation tools such as DASH and PRWE. How the deformity, objective functional outcome and subjective patient satisfaction affect one another remains a conundrum. The standard practice and general consensus is still highly variable between different countries. The decision for each patient should be based on individual needs weighted against the cost and additional risks of surgery.

**References**

16. Lindau T, Arner M, Hagberg L. Intraarticular lesions in distal fractures of the


