DISTAL END OF RADIUS PART II

Evidence Based [JBJS 93-A d NUMBER 8 d APRIL 20, 2011, 776]

1. Suggested operative fixation for fractures with post-reduction radial shortening 3mm, dorsal tilt .10 degrees, or intraarticular displacement or step-off 2mm as opposed to cast fixation.
   Strength of Recommendation: Moderate

2. Operative treatment of associated ligament injuries (SLIL injuries, LT, or TFCC tears) at the time of radius fixation is an option.
   Strength of Recommendation: Weak

3. We are unable to recommend for or against the use of bone graft (autograft or allograft) or bone graft substitutes for the filling of a bone void as an adjunct to other operative treatments.
   Strength of Recommendation: Inconclusive

4. We are unable to recommend for or against concurrent surgical treatment of distal radioulnar joint instability in patients with operatively treated distal radius fractures.
Strength of Recommendation: Inconclusive

5. We are unable to recommend for or against fixation of ulnar styloid fractures associated with distal radius fractures.
   Strength of Recommendation: Inconclusive

COMPLICATIONS

1. Malunion

Malunion following treatment of distal radius fractures continues to be a significant complication following nonoperative management. Malunion of the radius results in alterations to (1) the radiocarpal joint, (2) the midcarpal joint, and (3) the radioulnar joint. The effect of these changes can be significant with regard to both immediate functional impairment and the development of late degenerative changes.

Functionally, the shortening may account for the loss of grip strength that has been observed after malunion. There is also evidence that there is a functionally significant loss of motion at the radiocarpal joint after malunited extra-articular fractures. Finally, the extended position of the lunate and the scaphoid may result in a compensatory collapse at the midcarpal joint.

Corrective Osteotomy

The typical deformity of the distal radius malunion has three components:
(1) loss of radial inclination,
(2) loss of palmar tilt
(3) pronation of the fracture fragment.

Dorsal Displacement with Loss of Radial Inclination
The osteotomy is best performed at the site of the deformity. Typically an opening wedge osteotomy is performed and a corticocancellous graft is placed. It is notable that with the use of more rigid implants, it may be satisfactory to use cancellous graft alone. Stabilization of the osteotomy has been described using K-wires, dorsal plates, palmar plates, and external fixators.

Operative Approach: Plating

Indication: >5° Dorsal tilt

Assessment: 1. Measure amount of shortening between the head of the ulna and the ulnar corner of the radius
2. Measurement of Ulnar and dorsal tilt

Principles

Dorsal or Volar approach [Volar approach with newer locking plates]
Osteotomy: 2 cm proximal and should parallel to the articular surface
Use of K wires and laminar spreader
Tricortical graft

Typically the deformity is approached from the collapsed side, which is dorsal in most cases.
A longitudinal approach is performed and the extensor retinaculum is preserved to permit later coverage of the plate.
In cases of long-standing deformity or when significant shortening has occurred, it is critical to release the brachioradialis from its insertion on the distal radius.
Under C-arm guidance on the lateral view, a pin is inserted proximal

(preferably proximal to the proximal extent of the plate) and perpendicular to the radial shaft. A second pin is placed distally in the radial metaphysis parallel to the articular surface. In the case of severe or long-term deformity, it is helpful to use terminally threaded pins from a small external fixator.

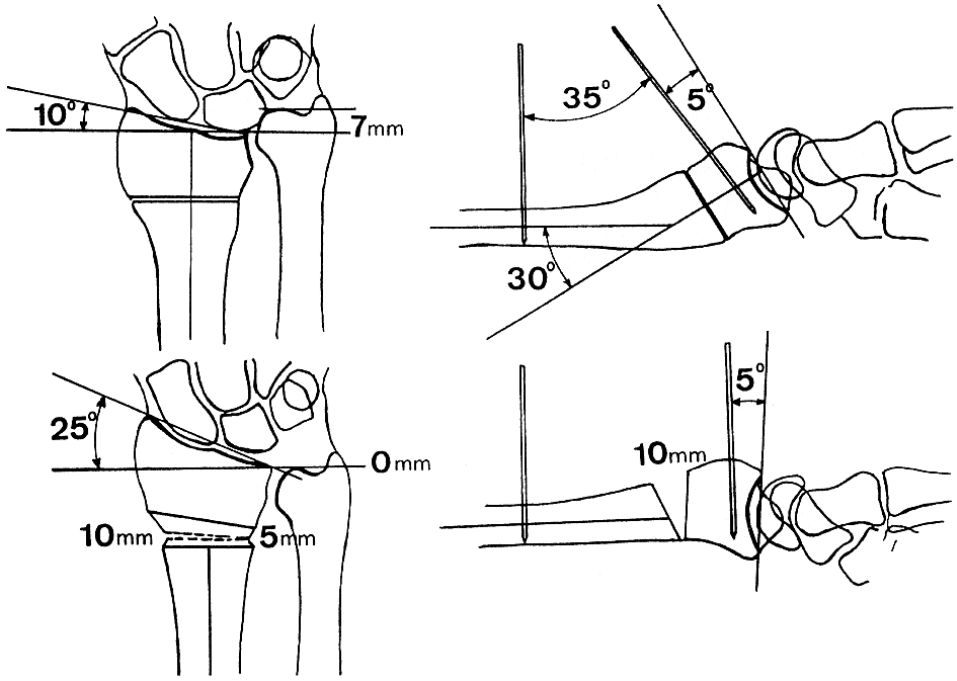
Once the osteotomy has been performed, the fixator can be used to maintain the radius in the reduced position while the bone graft and/or the plate is applied. An oscillating saw is then used to cut the bone. It is significant here again to assess whether correction should be limited to palmar tilt or should include correction of radial length and inclination as well. If the correction is for palmar tilt, then it is easier to leave the palmar cortex intact and hinge the distal fragment on the cortex.

If correction of length is to be achieved, then the osteotomy must be completed. The graft material is harvested, preferably from the iliac crest graft, particularly when radial length is required.

In elderly patients or when the distal radioulnar joint is not salvageable, the ulnar head may be harvested and inserted in the defect; however, it is generally not sufficient for complex deformities.

Once the graft has been inserted, the plate can be applied. In the case of a trapezoidal graft to correct radial length, it may be helpful to maintain its position with crossed wires to prevent displacing the distal fragment proximally when the plate is applied. Once the plate has been applied and the position confirmed radiographically, the retinaculum may be closed over the plate.

A second alternative is to make use of the more rigid volar locking plates to stabilize the osteotomy. The technique is similar, with placement of pins to verify the correction of the deformity. An extensile FCR radial artery approach may be used, which allows the osteotomy to be performed from the radial column to the intermediate column.



Ulnar Shortening Osteotomy

In cases when the radius has shortened without significant loss of palmar tilt or radiocarpal incongruity, it is preferable to perform an ulnar shortening osteotomy rather than a radial lengthening. The procedure, performed through a longitudinal approach to the ulna and fixed with a dynamic compression plate, has been extensively reported for ulnar abutment syndrome.

2. Nonunion

4/4000 is rare

Predisposing factors (JBJS 1961 43-A, 159-68)

- Infection
- Poor fixation
- Open fractures
- Impaired blood supply
- Immobilised for insufficient time
- Distraction of the fracture site

Treatment: Needs bone grafting and locking plate fixation

3. DRUJ

1. Any step off: at the volar ulnar fragment of the radius in the sigmoid fossa
2. Ulnar styloid type II: significant instability due to RU ligament
3. TFCC problem
4. Ulnar lengthening and impaction
5. Incongruity of distal RUJ

If after reduction and fixation of the radius: Translation of lower end of the ulna more than 1 cm or gross rotational instability

Ossesous: Radius: Palmar/Dorsal-Lunate facet requires cast for undisplaced and in Displaced, an ORIF required. Now assess IRUJ.

When IRUJ Unstable, a ligament repair is recommended.

Ulnar shortening is preferred

1. Darrach's
2. Modified Darrach's Procedure
3. Modified Sauve Kapandje operation
4. Prosthetic replacement: [Herbert] with corrective osteotomy: annular ligament using tendon strip around the prosthesis is important
5. Bowers Procedure: hemiresection interpositional technique combined with radial osteotomy in patients with post-traumatic deformity associated with degenerative changes at the distal radioulnar joint.

Darrach procedure

In elderly patients, total resection of the ulnar head still has a place in the treatment of derangement or osteoarthritis of the distal radioulnar joint. The disadvantages of this operation (reduction of grip strength and potential instability of the ulnar stump) are remarkably well tolerated.

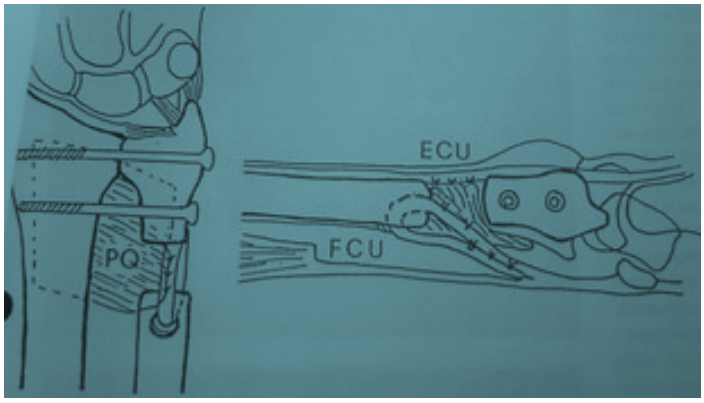
The most important technical details are

(1) the resection is not extended higher than the level of the ulnar neck

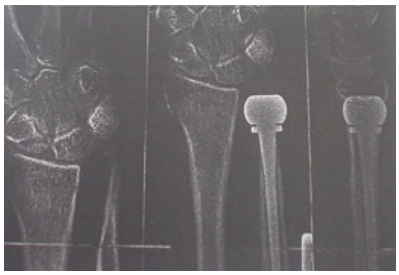
(2) the sheath of the extensor carpi ulnaris tendon is closed carefully to prevent dorsal subluxation.

3) when the ulnar head is subluxated before the operation, a primary tenodesis of the ulnar stump after head resection with ECU.

Modified Sauve Kapandje operation



Ulnar head replacement



4. Neurologic Injuries

Median Nerve

Acute carpal tunnel syndrome may be seen with either intra-or extra-articular fractures. Usually is seen in high velocity injury or when wrist is immobilized in a cast with wrist in acute flexion. Acute carpal tunnel syndrome that does not resolve rapidly after reduction is an indication for decompression.

Chronic Carpal tunnel syndrome in patients with malunited fractures

Ulnar nerve

Ulnar nerve injuries occur far less commonly than median nerve injuries. This nerve may have more excursions and is located at an increased distance from the displacement of the radius.

5. Carpal Malalignment

1. Malalignment that compensates for the tilt of the distal radius, which is extrinsic to the carpus. The lunate tilts in the same direction as the distal radius and the carpus adapts to this at the midcarpal joint with flexion of the midcarpal joint in dorsal tilt and extension in volar tilt in order to realign the hand on the forearm. This deformity is therefore extrinsic to the carpus and occurs without any disruption of the carpal ligaments.

2. Carpal malalignment can also be caused by associated carpal ligament disruption. DISI

7. Post traumatic arthritis

In 1986 Knirk and Jupiter correlated patient outcome with residual intraarticular incongruity. They found a 91% incidence of radiographically apparent arthrosis with any measurable intraarticular step-off and a 100% incidence with over 2 mm of articular step-off. Subsequent authors also emphasized the relationship of as little a 1 mm or more of articular incongruity with a worse clinical outcome.

Clinical data suggests that CT demonstrates intraarticular extension more accurately than plain radiographs and it has been shown to be superior in defining step-off and gaps in the articular surface of the distal radius.

Causes for arthritis:

1. Due to chondral injury
2. Due to deformity and incongruity: more than 1 mm step should not be accepted in young. Any dorsal angulation more than neutral is not acceptable
3. Due to associated Scapholunate dissociation

8. **Tendon Injuries**

Delayed extensor pollicis longus rupture occurs in roughly 0.3% of distal radius fractures. Interestingly, these ruptures occur most frequently in minimally displaced fractures treated nonoperatively. The rupture is usually painless and occurs late at 6 weeks to 3 months after injury.

Treatment is directed first at mobilizing the wrist and then performing an appropriate

transfer.

In closed fractures flexor tendon ruptures may occur either as a result of a rotational injury at the time of fracture or in a delayed fashion because of attrition. Usually secondary to attrition of the flexor pollicis on prominent hardware.

9. Complex Regional Pain Syndrome

Complex regional pain syndrome (CRPS) occurs in its early stages in up to 40% of fractures of the distal radius, although severe chronic cases with serious and sometimes devastating disability are fortunately less common, occurring in less than 2% of cases.

The mainstay of treatment is multidisciplinary, with effective analgesia often with the advice of a pain specialist and intensive physical therapy.

10. Complications of External Fixator

6% to 60% depending on how "major" and "minor" complications

Overdistraction during bridging external fixation has been implicated in producing worse digital motion, worse functional outcomes, and worse strength and pain scores.
May lead to non-union

Permanent loss of metacarpophalangeal motion.

Cutaneous Nerve Injury. Injury to the superficial radial nerve may be seen following open pin insertion, percutaneous half pin insertion, or with the use of supplemental K-wires in 16% to 21% of cases.

Pin track infection 8%

OUTCOME

1. Closed reduction and K wire Vs External fixation
   There was no statistically significant difference in the radiological restoration of anatomical features or the range of movement between the groups.

2. Cast Vs Percut K wire[Vol 87-B, Issue 6, 837-840]
   There is improvement in the radiological parameters compared with immobilisation in a cast alone. This does not correlate with an improved

functional outcome in a low-demand, elderly population.

3. Percutaneous K wire Vs Volar plate [J Bone Joint Surg Am. 2009;91:1837-46}

   Plate fixation is better

4. External fixation Vs Volar plate [J Bone Joint Surg Am. 2008;90:16-22]

   Plate fixation is better than external fixation combined with percutaneous pin fixation for the treatment of intra-articular fractures of the distal part of the radius.

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