Role of Wrist Arthroscopy in Treatment of Distal Radius Fracture

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1/6 all fractures seen in AED
- Complications frequent
- Peak incidence: geriatric
- Women > men
- Treatment cannot be standardized
Mechanism of Injury
Fall On OutStretch Hand (FOOSH)

90% : wrist extension
Tension forces: palmar
Compressive forces: dorsal
Dorsal comminution

Weber Hand Clinics, 1987
- **Colles’**: dorsal displacement
- **Smith’s**: palmar displacement
- **Barton’s**: intra-articular shear; dorsal or palmar
- **Chauffeur’s**: radial styloid
- **Die-punch**: lunate fossa
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ANATOMY: Radius

- Lister’s tubercle
- Sigmoid notch
- Scaphoid fossa
- Lunate fossa
Plain radiographs

CT Scan: Aids in evaluation of articular surface and surgical planning

MRI (rarely indicated): TFCC tears, tendon injury, median nerve injury, and occult fractures
Radiographs

PA view

Lateral view
Plain X-Rays

23°
Plain X-Rays
Plain X-Rays: Articular Surface

- Radial carpal congruency
- Distal radioulnar joint
Occult fracture
Pre-op planning
Complex comminuted fracture
Evaluation of articular surface fracture
Evaluate DRUJ
Evaluate fracture union
Evolution of treatment of distal radius fractures

- 1960’s: CR + cast
- 1970’s: pins & plaster
- 1980’s: External Fix; +/- pins &/or bone graft
- 1990’s: ORIF +/- Graft
- 2000+: B.G. substitutes, growth factors, locking plates

Wrist Arthroscopy
Why wrist arthroscopy?
Intra-articular step off

- Landmark article
- Retrospective review of 43 intraarticular fractures of distal radius to determine the components critical to outcome
- Initial X-rays assessed for:
  - Dorsal tilt
  - Loss of radial length
  - Degree of intraarticular incongruity
- Treatment consisted of:
  - CR and CAST
  - Percutaneous pins and plaster
  - External Fixation
  - Open reduction and internal fixation
  - Combination

Knirk & Jupiter, JBJS, 1986
Findings

- Loss of grip strength associated with loss of radial length
- Severe radial shortening precluded an excellent result
- Arthritis developed in 91% of those who had articular step-off
- Arthritis: 100% with > 2 mm of step-off
Findings:

- Only 11% with congruous joint surface developed arthritis
- Regardless of extent of initial step-off, the fractures in which articular congruity had been restored had better results
- No correlation between dorsal angulation nor radial length and subsequent arthritis

Reduce articular surface fracture within 2 mm to prevent arthritis

Knirk & Jupiter, JBJS, 1986
Accurate articular restoration was the most critical factor in achieving a successful result.
Retrospective review: 31 patients with intraarticular distal radius fractures

Subjective complaints and functional results directly correlated with radiographic findings:
- Increase dorsal tilt leads to loss of flexion
- Radial shortening of > 4 mm leads to decrease in forearm rotation
- Articular incongruity associated with pain in radiocarpal joint

Functional outcome depends on radial shortening, articular congruity and fragment alignment
Biomechanical consequences of Malreduction

- Dorsal angulation > 20° creates dorsal shift in scaphoid & lunate pressure areas and higher contact load (Pogue, JHS, ’90)
- When a Colles’ fracture settles 2.5 mm, one can expect an increase in ulnar axial load ~40% (Palmer & Warner, COOR, 1984)
- 10 mm radial shortening, reduced forearm pronation by 47% and supination by 29%
- 15 mm of shortening locked the joint (Bronstein & Trumble, JHS, 1996)
Factors affecting functional outcome of displaced intra-articular distal radius fractures.

Trumble TE, Schmitt SR, Vedder NB.

...reconstruction of articular congruity with internal fixation and/or external fixation can significantly improve functional outcome. The degree to which articular step-off, gap between fragments, and radial shortening are improved by surgery is strongly correlated with improved outcome.
The application of indirect reduction techniques in the distal radius: the role of adjuvant arthroscopy.  

Auge WK, Velazquez PA.  

- … surgical treatment of intra-articular distal radius fractures solely under fluoroscopic visualization appears inadequate to re-establish articular congruency.
What other injuries?

- Torn TFCC (54%)
- Scapholunate ligament injury (18%)
- Lunotriquetral ligament injury (12%)

Arthroscopy can:
- Repair of TFCC tear
- Fixation of SL or LT instability
<table>
<thead>
<tr>
<th>Study</th>
<th>Number and Type of Fractures</th>
<th>% TFCC Tears</th>
<th>% SLIO Tears</th>
<th>% LTIO Tears</th>
<th>Useful Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geissler et al(^{22})</td>
<td>60 (intra-articular)</td>
<td>49</td>
<td>32</td>
<td>15</td>
<td>22% presence of 2 concurrent soft-tissue injuries</td>
</tr>
<tr>
<td>Hanker(^{24})</td>
<td>173 (intra-articular)</td>
<td>61</td>
<td>8</td>
<td>12</td>
<td>55% of TFCC injuries were Palmer type 1D</td>
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<td>9% DRUJ instability</td>
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<td>22% osteochondral injuries</td>
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<td>18% intra-articular loose bodies</td>
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<td></td>
<td>70% dorsal capsule tear</td>
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<tr>
<td>Lindau et al(^{27})</td>
<td>50 (both extra-articular and intra-articular)</td>
<td>78</td>
<td>54</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Mehta et al(^{18})</td>
<td>31 (intra-articular)</td>
<td>58</td>
<td>85</td>
<td>61</td>
<td>19% osteochondral lesions</td>
</tr>
<tr>
<td>Richards et al(^{32})</td>
<td>118 (both extra-articular and intra-articular)</td>
<td>35 intra-articular</td>
<td>21 intra-articular</td>
<td>7 intra-articular</td>
<td>6% combined SLIO and LTIO tears</td>
</tr>
<tr>
<td>Shih et al(^{39})</td>
<td>33 (intra-articular)</td>
<td>54</td>
<td>18</td>
<td>12</td>
<td>18% chondral injuries</td>
</tr>
</tbody>
</table>
Problems in arthroscopy

- Swelling and fracture distorts normal landmarks
- Difficult visualization because of bleeding / haematoma
- Need time for debridement
- Risk of compartment syndrome
- Traction tower make fluoroscopy control difficult
- Cannot assess extra-articular parameters
Pre-op preparation

- Adequate imaging
- Degree of comminution
- Metaphysis comminution
  - Need bone graft?
- Neurology exam
- Oedema
- Primary close reduction + temporary slab
- Repeat X-ray
- Elevation / ice therapy
- Skin care
- Wait for at least 2 days
Intra-articular measurements

- Step
- Gap
Van der Linden and Ericson

Dorsal angle
Dorsal shift
Radial angle
Radial shift
Radial shortening

Figure 3.14. The measurement of deformity on the lateral radiograph as recommended by Van der Linden and Ericson. A: The dorsal angle (1) is the angle between a line perpendicular to the long axis and the articular surface indicated by a line joining its volar and dorsal margins of that surface. Dorsal shift is the increase in the distance from the long axis to the most dorsal point of the distal end of the bone (2). B: The measurement of radial shift as depicted by Van der Linden and Ericson. The radial angle (1) is the angle between a line perpendicular to the long axis and the radial articular surface, as indicated by a line joining its radial and ulnar margins. Shortening is the decrease in the distance that the styloid process projects distal to a perpendicular to the long axis drawn though the contour of the ulnar part of the wrist joint (2). Radial shift is the increase in the distance from the long axis to the most radial point of the styloid process (3). Reprinted with permission. Van der Linden W and Ericson R. Colles’ fracture. How should its displacement be measured and how should it be immobilized? J Bone Joint Surg 43A: 1285–1288, 1981.
Equipment

- Tourniquet
- External fixator
- Traction tower is not necessary
- Fluoroscopy
- 2.7mm 30° scope
- Shaver system
- Probe
- K-wire set
- Reduction clamp

Always prepare to convert to open
Preparation

- GA or Brachial plexus block
- Tourniquet on upper arm
- Esmarch exsanguinate
- Image intensifier
Use external fixator for distraction

- Apply external fixator in **frontal plane**
- Graphite rod preferred
Priority of reduction

- **Restore Extra-articular Alignment First**
- Radial length
- Radial shift
- Radial inclination
- Volar tilt

Achieved by distraction of external fixation + ulnar deviation + palmar flexion

Under Fluoroscopy control
Fracture fixation

- Radial styloid first
- Using 2 K-wires
- It becomes the corner stone
Before insert the scope

- To prevention of *compartment syndrome*
- Applied **tight bandage** on forearm to prevent accumulation of extravasation fluid
- Inflow by gravity (avoid pressurized pump)
Start arthroscopy examination

- 3-4 portal
- 4-5 portal
- 6R / 6U portal
- **Take time for adequate debridement**
- Examine SL ligament, TFCC, LT ligament and osteochondral lesions (mid-carpal portals)

*1-2 portal is not possible because of the external fixator*
Reduction of intra-articular fragments

- Mobilize the fragments before reduction
- Use probe to depress or elevate fragment
- Use K-wire as joy stick
- Reduction clamp to close gap
- May need bone graft to fill the metaphyseal bone defect and support the articular fragments
Bone fragments fixed with percutaneous K-wires (subchondral)

Intrafocal K-wires may be used to further improve the extra-articular alignment

External fixator as a neutralizing device

Release the over-distraction of the external fixator
Intra-articular fracture of distal radius
Intra-articular fracture of distal radius
Arthroscopy provide more accurate reduction

Ruch DS, Vallee J, Poehling GG, Smith BP, Kuzma GR

Arthroscopic reduction versus fluoroscopic reduction in the management of intra-articular distal radius fractures


Arthroscopic assisted reduction had a greater degree of supination, flexion and extension than patients undergone fluoroscopic assisted reduction surgery
Prospective randomized study

Doi K, Hattori Y, Otsuka K, Abe Y, Yamamoto H.

Intra-articular fractures of the distal aspect of the radius: arthroscopically assisted reduction compared with open reduction and internal fixation.


- Better wrist scores for overall outcome, range of motion, grip strength
- Recommended for all patients younger than 70 years who have an intra-articular displacement more than 1mm
Conclusion

- Arthroscopy assisted fixation can achieve more accurate intra-articular fixation
- Improve functional result
- Care to prevent complications esp. compartment syndrome
- Technical refinement is necessary
Thank You