DISTAL RADIAL FRACTURES
• One of the most common injuries of the upper extremity
• 1/6 all fractures treated in the ER
• Many subgroups
• Therapeutic challenge - no unanimity about treatment
• Significant disability - variable outcome
Distal Radius Fracture Complications (31%)

- Persistent neuropathies
- Malposition/malunion/nonunion
- Radiocarpal/Radioulnar arthrosis
- Loss of reduction/radial length
- Limited wrist motion
- Early Degenerative Joint Disease

Variability Outcome

Considerable Disability → Excellent Function
Incidence: Distal Radius Fracture

- Common skeletal injury
- Approximately 200,000/year
- 16% of all fractures treated in ER

*Ark and Jupiter -
Ortho Clin North Am 1993; 24: 205-20
• Colles  1814
• Pouteau  1783
• Barton   1838
• Goyrand
• Smith
“...the deformity will remain undiminished throughout life, the limb will at some remote period enjoy perfect freedom in all its motions and will be completely exempt from pain.”

*Abraham Colles, 1814*

Outcome Measurement
VARIABILITY

Spectrum of conditions

Low energy       High energy
Extraarticular   Complex intraarticular
No associated    Ligamentous injury
Elderly          Young
Osteoporotic     Well mineralized bone
Female           Male
Ultimate functional result → Anatomical restoration of the fracture
Important Radiological Parameters

- Radial Length
- Volar Tilt
- Radial Inclination
- DRUJ Congruity
- Significant Ulnar Styloid Fracture
Loss of Radial Length

- Incongruent DRUJ - painful restriction of motion
- Ulnar abutment
- Ulnar head subluxation
Malalignment

- Limitation of motion \textit{Fernandez 1993}
- Changes in load distribution \textit{Short et al.1987}
- Midcarpal Instability \textit{Taleisnik & Watson 1984}
- Increased Risk of OA
Functional Results Correlate with Anatomy

McQueen & Caspers, 1988
Jenkins & Mintowt-Czyz, 1988
Stewart, Innes & Burke, 1985
Conservative Treatment

• Casting maintains reduction in only 33% of cases

• Loss of reduction associated with
  • Unstable fracture
  • Significant displacement
  • Extensive dorsal comminution
Distal Radius Fracture Loss of Reduction in Plaster Immobilization

- Early loss 2-60%
- 25 pts with severely displaced fractures treated by casting 80% had some loss of reduction
  
  *Howard et al, JBJS 71B, 1989*

- 100 pts treated with plaster immobilization
  71% had dorsal angulation, 47% shortening of the radius, and 32% loss radial inclination

  *Altissimi et al, Inter Ortho 18, 1994*
- 20° dorsal tilt - decreased grip strength and endurance (Jenkins et al. JBJS 1987)

- Radial inclination decreased 10° or less - abnormal loading patterns on articular surface

- Alteration DRUGJ mechanics
Final dorsal angle compared with dorsal angle after reduction in fifty eight severely fractures (original angle of 40° or more)

Final Dorsal Angle (Degrees)

<table>
<thead>
<tr>
<th>Residual dorsal</th>
<th>&lt;10</th>
<th>10-19</th>
<th>20-29</th>
<th>&gt;=30</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>angle degree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>28 (48.3)</td>
</tr>
<tr>
<td>10-19</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>22 (37.9)</td>
</tr>
<tr>
<td>&gt;=20</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>8 (13.8)</td>
</tr>
<tr>
<td>TOTAL(%)</td>
<td>12(21)</td>
<td>15(26)</td>
<td>17(29.3)</td>
<td>14(24.1)</td>
<td></td>
</tr>
</tbody>
</table>

(Van der Linden & Ericson, 1981)
Risk of DRUJ DJD

• Shortening 1mm 50% risk

Symptoms

• Radial angulation 5° difference
  increased risk of symptoms 90%

• Dorsal angulation 10° difference
  increased risk of symptoms 80%
Accepted Treatment

- “One hundred fractures of the distal radius with dorsal displacement were treated by closed reduction and a plaster cast.”
- Dorsal angulation occurred in 71 patients
- Radial shortening occurred in 47 patients
- Flattening of the radial angle occurred in 32 patients

Effects of Distal Radius Fracture Malunion on Joint Mechanics

- A cadaveric study employing Fuji pressure sensitive film to evaluate stress on simulated distal radius fracture malunions
- > 2mm shortening increases load to lunate fossa
- >20° volar/dorsal tilt from normal shifts load to the dorsal lip of the radius and small areas of high load concentration

Pogue et al, JHS 15A, 1990
Immobilization Distal Radius Fracture Loss of Reduction in Plaster

- Remanipulation often leaves residual deformity

*McQueen, JBJS 68B, 1986*
Malmo Sudy

- Extra articular fractures
- Risk of radiocarpal DJD:
  - Shortening - 1mm  20% risk
  - 2mm  50% risk
- Dorsal angulation
## Malmo Study

<table>
<thead>
<tr>
<th></th>
<th>Extraarticular Fracture</th>
<th>Intraarticular Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degenerative DRUJ</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Degenerative RCJ</td>
<td>21%</td>
<td>40.5% p&lt;0.05</td>
</tr>
</tbody>
</table>
Loss of Reduction Results in

- Dorsal angulation/loss of radial inclination
- Shortening of radius
  - Ulnar impaction
- Distal radial ulnar joint (DRUJ) incongruity
  - DRUJ arthritis/instability
Conservative Treatment

- Casting maintains reduction in only 33% of cases
  

- Loss of reduction associated with
  - Unstable fracture
  - Significant displacement
  - Extensive dorsal comminution
## Malmo Study

<table>
<thead>
<tr>
<th></th>
<th>Congruity</th>
<th>No Congruity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degenerative DRUJ</td>
<td>18%</td>
<td>46%</td>
</tr>
<tr>
<td>Degenerative RCJ</td>
<td>29%</td>
<td>69% p, 0.001</td>
</tr>
</tbody>
</table>
Intraarticular Fractures

- Radiographic Evidence of Arthritis
- 100% patients with articular incongruity > 2mm
- 11% patients with no articular incongruity

(Knirk & Jupiter: JBJS 68A:647-659, 1986)
Articular Congruity

- Experimental - Baratz et al, 1993
- Clinical - Cooney et al, 1979
  Jenkins et al, 1987
  Knirk & Jupiter, 1986
  Stewart, Innes, Burke, 1985
  McQueen & Capenl, 1988
  Kopylov, 1983
A. Closed
B. Open
Osteoporotic bone
Pathological fracture
Associated wrist condition
Classification

First Layer: Condition of the bones and wrist joint

- n: normal
- o: osteoporotic (based on mc index)
- p: pathological fracture
- r: preexisting wrist pathology (e.g. SLAC wrist)
Classification

Third Layer: Anatomical description of the fracture, carpal bone and ligament injuries

I. Extraarticular
II. Intraarticular

w: stable DRUJ/no carpal fractures or ligament injuries
x: unstable DRUJ/no carpal fractures or ligament injuries
y: stable DRUJ/with carpal fractures or ligament injuries
z: unstable DRUJ/with carpal fractures or ligament injuries
Classification

Second Layer: Soft Tissue Injury

A: CLOSED
B: OPEN
I. Extraarticular

- S. STABLE
- U. UNSTABLE
Criteria for Instability

- Greater than 20° angulation
- Greater than 10 mm of axial radial shortening
- Greater than 2 mm articular incongruity
- Extensive comminution of dorsal cortex
- Comminuted of dorsal & volar cortoces
Criteria for Instability

- Irreducible fracture
- Loss of reduction
- Open fracture
- Bilateral fracture
- Polytrauma fracture
The Ulson Device in the Management of Unstable Distal Radius Fractures

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T. Wolff, MD
A. Gupta, MD
D. Cautilli, MD
A. Mejia, MD

Christine M. Kleinert Institute for Hand & Microsurgery
Division of Hand Surgery
University of Louisville School of Medicine
Louisville, Kentucky
I. Extraarticular

- S. STABLE
- U. UNSTABLE
Results

• Clinical Findings
  • Supination: mean, 70°
  • Pronation: mean, 81°
  • Grip Strength: 63% of contralateral side
Results

- Clinical Findings
  - Dorsiflexion: mean, 46°
  - Volar flexion: mean, 48°
  - Radial deviation: mean, 16°
  - Ulnar deviation: mean, 22°
Patient Population and Method

- From 1987 to 1996
- 97 fractures, 96 patients
- 41 males, 55 females
- Mean age 60 (range, 14-96)
- Pre- and postoperative radiographs
Conclusion

In closed-reduction fractures, the Ulson device

- Simple and inexpensive ($150-$200)
- Minimal complications
- Easy removal (under anesthesia)
- Useful adjunct to management of distal radius fractures
Current Surgical Options

- Rush rods
- Percutaneous k-wires
- Intrafocal k-wires
- ORIF
- Plates
- External fixation
- Pins and plaster
II. Intraarticular

1. **CORONAL:** i. Palmar; ii. Dorsal

2. **SAGITTAL:** i. Scaphoid fossa; ii. Lunate fossa; iii. Scapholunate ridge

3. **BOTH CORONAL & SAGITTAL:**
   i. 3 part; ii. 4 part

4. **AXIAL** (Die Punch)

5. **Intraarticular DRUJ** only

6. **COMMINUTED:** 5 or more parts
Results

Radiographic Findings (at final exam)

- Radial inclination: mean, $24^\circ$
- Loss of radial length: mean, $-0.54\text{mm}$
- Volar tilt: mean, $14^\circ$
Conclusion:

- Provides intramedullary fixation
- Restores radial length
- Maintains radial and volar tilt
- Maintains reduction--wide age range and Frykman Types
Complications of External Fixator

- Over distraction
- Pin tract infection
- Wrist stiffness
- Fractures: Metacarpal, Radial
- Collapse after removal

Intraarticular

Coronal  Dorsal  ORIF
Volar  No bone grafting
Buttress plate only
II. Intraarticular

1. CORONAL: i. Palmar; ii. Dorsal
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   i. 3 part; ii. 4 part

4. **AXIAL** (Die Punch)

5. Intraarticular DRUJ only

6. **COMMINUTED**: 5 or more parts
After T. G. Huff
Conclusion:

- Prevents pin migration
- Allows mobilization of hand
- Promotes rotational stability
- Allows lateral compression of fractures