1 Distal Radius Fractures
   • Wichita Orthopaedic Trauma Forum
   • Bernard F. Hearon, MD
   • January 27, 2016

2 Epidemiology
   • Medicare pts, New Hampshire, 1998–2004
   • DRFx – 125 per 10,000 beneficiaries
   • Rate for whites 2.3x rate for non-whites
   • Rate for women 4.8x rate for men
   • Treatment rates similar across races (83% nonoperative, 10% CRPP, 7% ORIF)
   • ORIF increased (1998 = 5%, 2004 = 8%)

3 Era of Naivete (Pre–1895)
   • Ancient Egyptians scrolls – fx manipulation, splints of wood & linen, grease & honey
   • Hippocrates, Greece, father Western medicine – misdiagnosed DRFx as wrist dislocations
   • Abraham Colles, 1814 – recognized DRFx
   • Guillaume Dupuytren – raised awareness DRFx
   • Plaster of Paris introduced in 1850s

4 Era of Invention (1895–1965)
   • Wilhelm Rontgen, 1895 – roentgenography
   • Albin Lambotte, 1908 – percutaneous wires
   • Lorenz Bohler – pins-in-plaster
   • Donald Murray – adhesive traction device
   • Anderson & O’Neill, 1944 – external fixation
   • Lane & Lambotte – advocated internal fixation
   • Osteosynthesefragen (AO), 1958 – Swiss

5 Era of Refinement (1965 – Present)
   • Kapandji, 1970s – percutaneous pinning
   • External fixation devices in 1980s
   • Dorsal Pi & Forte plates in 1990s
   • Volar locking plates in 2000s
   • Dorsal wrist spanning plates in 2000s

6 Most Consistent Predictors of Fracture Instability
   • Significant initial fracture displacement
   • Advanced patient age
   • High degree metaphyseal comminution
   • Significant radial shortening

7 AAOS Clinical Guidelines – Evidenced-Based, Moderate Support
   • Operative fixation if radial shortening > 3mm, dorsal tilt > 10 degrees, step-off > 2 mm
   • Non-removable immobilization for closed treatment
   • Post-reduction true lateral to assess DRUJ
   • Early wrist ROM not necessary after ORIF
   • Adjuvant Vitamin C to prevent pain syndrome

8 Appropriate Use Criteria
   • AO / OTA fracture type (A, B or C)
   • Mechanism of injury (high- or low-energy)
• Function (homebound, independent, normal, high)
• Co-morbidities (ASA 1–3 vs ASA 4)
• Associated injuries (none, Gustilo I or II vs III, median nerve injury, other ipsilateral injury)

9 AUC Treatment Ratings
• Appropriate (ratings 7–9) – treatment acceptable, reasonable and likely to improve patient outcome
• May be appropriate (ratings 4–6) – uncertain for indication but may be acceptable, reasonable
• Rarely appropriate (ratings 1–3) – option lacks clear benefit/risk advantage and requires careful documentation before proceeding

10 Radiographic Evaluation
• Anatomic tilt PA and lateral projections are tangential to the radiocarpal articulation
• Ulnar variance is not significantly changed by forearm rotation (varies only 0.6 mm)
• CT scans identify articular surface depression, extent of comminution, DRUJ involvement
• Two-week postoperative XRs of DRFx rarely change management but increase cost

11 Outcome Measures – No Universally Accepted Gold Standard
• Short Form Health Survey (SF-36)
• European Quality of Life (EuroquOL-5D)
• Disabilities Shoulder, Arm, Hand (DASH)
• Patient-Rated Wrist Evaluation (PRWE)
• Jebsen-Taylor Test (JTT)
• Michigan Hand Outcomes Questionnaire (MHQ)
• Gartland and Werley score

12 Evidenced-Based Treatment of DRFx
• DRFx classifications lack observer reliability and prognostic significance
• Most patients have good functional outcomes even with post-traumatic arthrosis
• Sugar tong splint no better than short-arm splint in preventing fracture displacement
• Rigid fixation in osteoporotic fractures has no significant functional benefit
• Outcome with volar locking plates no better than external fixation at one year
• Most displaced ulnar styloid fractures do not require ORIF as long as DRUJ is stable
• No difference between bone autograft and substitutes except for donor site morbidity
• Early mobilization is safe but does not improve functional outcome

13 Trends in Internal Fixation
• ABOS Part II exam (1999–2007) – ORIF of DRFx increased from 42% to 81% (Koval, 2008)
• Medicare pts ORIF increased from 3% in 1996–97 to 16% in 1998–2005 (Chung, 2009)
• Patients more likely to have ORIF if treated by hand surgeon (Chung, 2011)

14 Is Early Internal Fixation Better Than Cast Treatment for Well-Reduced Unstable DRFx?
Koenig et al., JBJS 2009; 91-A: 2086–93
• VRL plate yields higher chance painless union
• Plating provides better outcome than cast by only 0.08 quality-adjusted life years (29 days)
• Older patient tolerant of malunion may prefer nonoperative treatment
• Economic, decision analysis Level II (Dartmouth)

15 ▸ Volar Plating
• Use locking screws not locking pegs to optimize construct stability (Martineau, 2008)
• Locked unicortical screw 75% AP dimension same as bicortical fixation for type A fx (Wall, 2012)
• Pronator quadratus repair after volar plating does not improve outcome (Tosti, 2013)
• Use AP lunate depth on lateral XR or sagittal MRI to estimate longest screw length (Ljungquist, 2015)

16 ▸ Indications for Volar Plating
• Volar shear fractures
• Radial shortening > 3 mm
• Dorsal tilt > 10° from neutral
• Intra-articular step-off > 2 mm
• Beware volar lunate facet fracture!

17 ▸ VLP Position is Crucial
• Plates > +2 mm from VCL or within 3 mm volar rim increase chance of rupture
• Remove prominent plates > 6 months, especially if flexors symptomatic

18 ▸ Surgical Treatment of DRFx with VLP vs Conventional Percutaneous Methods
Karantana et al., JBJS 2013; 95–A: 1737–44
• Randomized, controlled trial 138 pts displaced DRFx rx VLP (n = 66) or percutaneous (n = 64)
• VLP better restoration anatomy, grip strength
• VLP better outcomes at 6 wks, but no significant functional differences at 12 wks or 1 yr
• Therapeutic Level I study (England)

19 ▸ Indications for Dorsal Plating
• Comminuted, dorsally displaced fractures
• Dorsal shear fractures
• Comminuted, intra-articular fx requiring direct visualization of the radiocarpal joint
• Fractures associated with other carpal injuries requiring dorsal approach (proximal scaphoid)

20 ▸ Fractures of the Dorsal Articular Margin of the Distal Radius with Dorsal RCJ Subluxation
Lozano-Calderon et al., JBJS 2006; 88–A: 1486–93
• 20 pts w/dorsal marginal fx rx w/dorsal plating
• 18 had volar injuries; 14 had central depressions
ROM – DF 56°, VF 59°; grip strength 85%
One recurrent dorsal sublux after plate removal
Therapeutic Level IV study (Mass General)

21 Dorsal Spanning or Bridge Plating
• 1998 Burke – alternative to external fixator
• 2005 Ruch – DRFx w/proximal extension
• 2006 Wolf – more stable than external fixator
• 2006 Hanel – apply distally to index metacarpal
• 2015 Lauder – excellent functional outcomes
• 2015 Lewis – fixation to index metacarpal minimizes risk of extensor entrapment

22 Indications for Bridge Plating
• Comminuted, unstable distal radius fractures
• DRFx with metaphyseal-diaphyseal extension
• Polytrauma pts who need arm for mobility
• Comminuted, osteoporotic, intra-articular fx in elderly (+/- K-wires, bone graft)
• As neutralization device for radiocarpal dislocations, distal radius shear fractures

23 Functional Outcomes Following Bridge Plate
Fixation for Distal Radius Fractures
Lauder et al., JHS 2015; 40-A: 1554–62
• 18 pts min 1-yr F/U after dorsal bridge plating
• Wrist ROM – DF 46°/56°, VF 43°/58°
• Grip strength 86% overall; 95% if dominant wrist
• No cases of infection, tendonitis or tendon rupture
• Therapeutic Level IV study (Univ Washington)

24 Indications for External Fixation +/- K-Wire Fixation
• Grossly contaminated, open, intra-articular fx
• Unstable polytrauma patients
• Patients unable to have prolonged procedure
• As an adjunct with additional internal fixation
• While awaiting resolution soft tissue swelling

25 Unstable DRFx Treated with External Fixation, Radial Column Plate, or Volar Plate
Wei et al., JBJS 2009; 91-A: 1568–77
• 46 pts randomized ex fix (22), VLP (12), RCP (12)
• DASH for VLP better at 3 mo, but no differences among 3 groups at 6 and 12 months
• No differences in wrist ROM after 3 months
• No difference in grip strength at one year
• Therapeutic Level I study (Columbia Univ)

26 Complications of DRFx
• Post-traumatic wrist pain, stiffness
• Post-traumatic wrist arthrosis
• Loss of closed reduction
• Loss of internal fixation
• Post-fracture or postop tendon rupture
• Distal radial malunion, nonunion
• Post-traumatic carpal tunnel syndrome
27. Loss of Fixation of the Volar Lunate Facet Fragment in Distal Radius Fractures
   Harness et al., JBJS 2004; 96-A: 1900–08
   - Case report on 7 pts from multiple centers on volar shearing fracture distal radius lunate facet
   - All 7 fx displaced after apparent adequate ORIF
   - Deforming forces – VRUL, ulnar radiocarpal ligaments
   - May need supplemental fixation, K–wires or ex fix
   - Therapeutic Level IV study (Mass General)

28. Distal Radial Malunion
   - Radial inclination < 10°
   - Volar tilt > 20°, dorsal tilt > 20°
   - Radial height < 10 mm
   - Ulnar variance > 2 mm
   - Intra–articular step or gap > 2 mm

29. Correction of Post–Traumatic Wrist Deformity by Osteotomy, Bone Grafting, Internal Fixation
   Fernandez, JBJS 1982; 64-A: 1164–78
   - Case report 20 pts w/distal radial malunions > 25°
   - Indications are based on age, deformity, functional limitation, wrist pain and appearance
   - Contraindication is post–traumatic wrist arthrosis
   - Preoperative planning to correct 3D deformity
   - Therapeutic Level IV study (Switerland)

30. Flexor Tendon Rupture After Volar Plating DRFx
   - Incidence <1%, not related to specific system
   - Involves rupture of FPL and/or index FDP
   - Rupture occurs > 6 months postoperative
   - Cause – plates placed distal to watershed line or that lose reduction from volar surface
   - Tendon ischemia, attritional wear & failure

31. DRFx: Risk Factors for Complications After Locked Volar Plate Fixation
   Soong et al., JHS 2008; 36-A: 3–9
   - Retrospective review 594 pts, two institutions
   - 47 complications, 26 plate–related
   - 14 pts with tendon irritation (one tendon rupture)
   - Beware late tendon irritation may lead to rupture
   - Prognostic Level IV study (Mass General)

32. Predictors of Acute Carpal Tunnel Syndrome Associated w/DRFx
   Dyer et al., JHS 2008; 33-A: 1309–13
   - 50 pts had release acute CTS assoc w/ORIF DRFx
   - Prevalence of acute CTS in surg rx DRFx was 5.4%
   - Only fracture translation was predictor of acute CTS
   - 35% fx translation in women < 48 years of age
   - Prognostic Level III study (Harvard)