Maintenance of Certification Lecture:

*Intraarticular fractures of Distal Radius:*
  overview, complications
  
  *Role of Arthroscopy*

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“The authors have no conflicts to disclose related to the subject of this presentation.”
Distal Radius Fracture

Incidence

- Most common UE fracture
- ~15-18% of all extremity fractures
- Two peak age ranges
  - 6-12 years
  - > 60 years (F>M)
- Pathologic/osteopenia

High energy

- Young adults (MVA)
- Working males (fall from height)
Medicolegal Concerns ("bad" results)

Frequency malpractice DRF:

- **Increasing United States**
  - Common complaint
  - "Thirty-eight of 70 cases resulted in an indemnity payment." - NYC

- **2nd - malpractice compensation Finland**

- **Increasing UK** "... clustered ... particularly wrist fractures (48%)."

Lawsuit verdicts and settlements involving reflex sympathetic dystrophy and complex regional pain syndrome. Crick & Crick JSOA 20:153-7; 2011

Importance of complications

“in cases involving a diagnosis or misdiagnosis of RSD or CRPS, over half resulted in a substantial verdict or settlement for the plaintiff.”
Treatment Goal:

Restoration of pre-fracture function and Quality of life
Distal Radius Fracture

“Good” Results:

- “Anatomic” or functional alignment
- Stability
- Acceptable pain
- Long-term benefit
- Addresses patient-specific concerns
Distal Radius Fracture

Basic management principles:

Relatively ignored” in DRF

- Reduction
- Stabilization
  - Inherent
  - Device
- Neutralization

Wake Forest Baptist Health
Important factors

- Sustained restoration anatomy
- Satisfied patient
- Avoidance Complications
Drivers of Patient Outcome

- Function correlates – *maintenance/restoration of normal (functional) distal radial anatomy and stability*

  Radius / Ulna
  - Palmar tilt: 11°
  - Radial height: 12 mm
  - Radial inclination 23°
  - Ulnar variance:
    - neutral PA view
The Impact of Patient Activity Level on Wrist Disability after Distal Radius Malunion in Older Adults. Nelson et al J Orth Trauma 2014

96 patients > 60 yo with malunion
High-activity participants with a distal radius malunion were compared to high-activity participants with well-aligned fractures.

“Even among highly active older adults, distal radius malunion does not impact functional outcomes. Judicious use of operative management is warranted provided heightened complication rates.”
Drivers of Patient Outcome

• Function correlates - *maintenance/restoration of normal distal radial anatomy and stability*

• Cartilage & ligament damage impact results
Drivers of Patient Outcome

- HRQL correlates – pain, stiffness and function
- Physiologic age significant factor
- Digital stiffness correlates with poor functional outcome -- CRPS
- Comorbidities – fragility etc
Indications for Surgery

• Failure Closed Care
• Inability to obtain or maintain reduction
  ➢ Intraarticular injury
  ➢ Carpal instability
• Neurovascular injury
• Osseous instability
Indications for Surgery

• Failure Closed Care
• Inability to obtain or maintain reduction
  ➢ Intraarticular injury
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• Neurovascular injury
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Indications for Surgery

Care:
Patient–centric
Demand–matched
Treatment goals

Anatomic / Radiographic

• Restore articular congruity
  
  *Gap/step-off <= 2 mm*
  
  *Radial length within 2 mm of normal*
  
  *Dorsal tilt, neutral to no more than 10 º*
  
  *Radial inclination*

• Address Ligamentous damage

• Manage fragility
Evaluation

Clinical examination

• Motor and sensory of median, ulnar & superficial radial
  R/O acute CTS
• determine if open fracture
• vascular status
• Assess soft tissues injury & stability
Imaging

- Radiographic evaluation
  - Standard AP & lateral
  - Oblique radiographs
  - Specialized views
- CT and MRI
  - Articular integrity
  - Ligamentous disruption
DRF Treatment

Radial inclination

- Correlates least with outcome
- Loss inclination produces radial displacement of carpus and hand (cosmetic)
- Occasional symptomatic ulnar prominence/ pain
Principles of treatment

Goals:

• Restore articular congruity
• Gap/step-off <= 2 mm
• Radial length within 2 mm of normal
• Dorsal tilt, neutral to no more than 10 °
• Radial inclination
Closed treatment

- Non-displaced fractures
- Closed reduction

Immobilization

*Short arm or long arm cast*

*thermoplastic splint or bivalve splint*

*Off-the-shelf splint*

- Follow up 7-10 days to check for displacement
- Avoid extreme wrist positions
Surgical Options:

• Closed reduction percutaeanous fixation

• External fixation

• ORIF – plates
  
  *Volar vs. dorsal approach*
  
  *Locking vs. non-locking*
  
  *Fragment specific plate*
  
  *Intramedullary*

• Bridge plate

• Arthroscopic assisted?
Distal Radius Fracture

Volar locked Plating:

• >30 systems
DRF Complications  McKay JHS 26;916-22;2001

6-80%

Loss of motion (0-31%)  Nonunion (0.7-4%)
Delayed/nonunion (0.7-4%)  Ostemyelitis (4-9M%)
Nerve related (0-17%)  Malunion (5%)
Pain syndromes (0-8%)  Tendon (0-5%)
Hardware related (1.4-26%)  Keloid (3%)
Radioulnar (0-1.3%)  Ligament injury (98%)
Arthrosis (7-65%)  Dupuytren's (2-9%)
Unrecognized (2%)
DRF intraarticular
Associated Injuries – common

41/60 (61%) soft tissue injury associated with intraarticular fracture

- 26 TFCC
- 19 SL tear
- 9 LT tear
- 13 two types of soft tissue injuries

(Geissler et al JBJS 1996)
DRF – Complications

Pain

- Diffuse
- Mechanical
  - Instability
  - Cartilage
- Neuropathic
  - Neuritis
  - Compression
  - CRPS
Complex Regional Pain Syndrome

Fracture Distal Radius

“most common injury producing reflex sympathetic dystrophy”

Post traumatic RSD (Colles’ fractures)

Significant loss of *cortical and trabecular* bone compared with non-RSD fractures
Complex Regional Pain Syndrome
Fractures of the Distal Radius

Incidence:

• Retrospective series 1-4%
• Prospective studies 25-40%
• Differences related to
  • cultural management
  • recognition / reporting
  • awareness
Jury Verdicts related to Reflex Sympathetic Dystrophy Crick JC & Crick BC Poster #3; 26th SOA Meeting, Amelia Island, Florida 2009

58 lawsuits

Westlaw database; Florida; RSD

45 jury verdicts
Plaintiff 13 (substantial)
Features of algodystrophy ten years after Colles’ fracture.

Field F, Warwick D  J Hand Surg  17(B):318-20; 1992

55 cases

Followed for 10 years

- 26% showed features of RSD
- “poor finger function” at 3 months
- correlated with RSD at 10 years
Complex Regional Pain Syndrome
Fractures of the Distal Radius

Natural History:

- *Symptoms / Signs within 2 - 4 weeks*
- "Tenderness" decreases by 19 weeks
  
  18% at 1 year

- Vascular instability slower to respond
  
  29% at 1 year

- Swelling decreases atrophy

- "Stiffness" most persistent complaint
  
  65% at 1 year
Complex Regional Pain Syndrome

Clinical Definition:

- Regional pain
- Autonomic dysfunction
  - Vasomotor
- Atrophy (trophic)
- Functional impairment
Complex Regional Pain Syndrome

IASP Criteria 1994:

- “Adequately” sensitive
- “poor” specificity

Budapest Criteria 2007

- Empirical validation
- Statistical revisions IASP
Budapest Criteria

- **CRPS** -- an array of clinical conditions
- **Regional pain** -- disproportionate
- **Abnormal sensory, motor, vasomotor, sudomotor, and/or trophic**
- **Variable progression over time**
Complex Regional Pain Syndrome

Cigarette Smoking:

- **Linked** (68% vs 37%) \((p<.0001)\)
- **Postulated pathogenesis**
  - increased sympathetic tone
  - vasoconstrictor hypersensitivity
  - unknown \(\text{An JHS 1988}\)
Complex Regional Pain Syndrome

Presentation:

- Acute / Obvious
  - pain - “burning”, “tearing”
  - severe numbness
  - mild to mod edema
Complex Regional Pain Syndrome

Presentation:

Indolent

• “poor” patient
• problem sleeping
• stiffness / atrophy
• delayed healing
The role of bone scintigraphy in diagnosing reflex sympathetic dystrophy. Lee G... JHS 20A:458;1995

Review of English Literature

19 studies
RSD and Bone Scan

Diagnosis remains clinical
Three-Phase
sensitivity of ~ 50% @ 20-26 weeks of onset
poor correlation after 26 weeks
The role of bone scintigraphy in diagnosing reflex sympathetic dystrophy. Lee G... JHS 20A:458;1995

“... three-phase bone scintigraphy should not be used as a major criterion in diagnosing reflex sympathetic dystrophy”
Complex Regional Pain Syndrome

Treatment Strategies:

• **Prevention** -- vitamin C

• **Block harmful effects of pain**

• **Multiple levels of initiation & perception**

• **Interventions**
  - Physical modalities
  - Pharmaceutical
  - Surgical

VITAMIN C complex:
• 416 pt with 427 fractures
• 200,500 & 1500 mg/day
• Randomized trial

Reduced prevalence of CRPS 500 mg dose
Pharmacologic agents:

• *Steroids*
• *Antidepressants*
• *Calcium channel blockers*
• *Anticonvulsants*
• *Adrenergic agents*
• *NMDA blocking agents*
Complex Regional Pain Syndrome

Therapy

• ROM

• Contrast baths

• Stress Loading:

Dystrophile machine Watson
Continuous Block:

- Cervical epidural
- Lumbar Epidural
- Continuous Plexus or field
Complex Regional Pain Syndrome

Surgical intervention (>300pts)

- Wake forest experience with
- Control of pain by autonomic block --
  Safe
- Exacerbation < 1%
- Pre and post op block 3-7 or > days
Acute CRPS
Median Nerve Symptoms

Unresponsive Medical Management

Early neurolysis
**Best Results:**

- *Early recognition*
- *Intervention*
  - *decrease pain*
  - *interruption dystrophic “cycle”*
**DRF Complex Regional Pain Syndrome**

**Prevent:**
- pain
- contracture
- atrophy
Late Management:

- Surgical intervention
  - nociceptive foci
  - Correct deformity

Can be done safely, is appropriate and is standard of care
DRF Complications

- Infection
DRF Complications

• Infection
• Stiffness
DRF Complications

- Infection
- Stiffness
- Hardware failure
  - Asymptomatic
  - Symptomatic
- Arthritis

From Tun-Lin et al
DRF – Complications

Tendon rupture

- *EPL, EDC rupture / attrition – closed treatment*
- *EPL rupture after DRF*
- *FPL rupture after volar plating*
DRF – Complications

- Malunion
- Non-union
- Arthritis
Pathogenesis:
- Atrophic nonunion
- “Over” distraction
- Osteopenia
- CRPS
Distal Radius Nonunion

Associated events:

- Smoking
- Alcohol abuse
- Age
- relative
# Distal Radius Nonunion

## Incidence:

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<td>Smith</td>
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<td>5</td>
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<tr>
<td>Segalman</td>
<td>1998</td>
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*Approximately 74%*
15 patients (8 male; 7 female)

- fracture of the ulna $n=6$
- dislocation DRUJ $n=4$
- Arthrodesis $n=3$
- plate fixation and autogenous bone grafting $n=12$
- distal ulna excised (bone graft) $n=8$
- z-lengthening brachioradialis and FCR $n=4$
- distraction histogenesis (Ilizarov) $n=2$

Salvage to fusion in 1

Nonunion av 56 mo.
Un-united fractures of the distal radius: a report of 12 cases. Segalman... JHS 23A:914;1998

12 cases (11 patients)

Wrist fusion if less than 5 mm of subcortical bone
Posttraumatic radial club hand.
Ring D..., Jupiter JB JSOA 13:164 ;2004
Posttraumatic radial club hand.
Ring D... Jupiter J. JSOA 13:164 ;2004

Wake Forest Baptist Health
Posttraumatic radial club hand.
Ring D..., Jupiter J  
JSOA 13:164;2004
DRF Treatment options

THE EVIDENCE
External fixation vs. Plating (Chung JHS 2005)

1980 to 2004, 46 articles

- 28 (917 patients) external fixation
- 18 (603 patients) internal fixation

- Meta-analysis

- NO differences in pooled grip strength, ROM, radiographic alignment, pain, and physician-rated outcomes

- Ex-fix: higher infection, hardware failure, and neuritis

- ORIF: higher rates of tendon complications and early hardware removal.
Functional outcome of unstable DRF: ORIF with a volar fixed-angle plate versus ex-fix. (Wright et al, JHS 2005)

- 11 EF, f/u 47m; 27 ORIF f/u 17m
- The PRWE and DASH scores for the groups were equivalent,
- intra-articular step-off, volar tilt, and radial length were better in the ORIF group.
- There were few complications, implant removal was not necessary, and early postsurgical wrist ROM was initiated without loss of reduction.

110 patients

- EF- 68
- VLP-42

1 year – Pain, ROM, Green & O’Brien scores

“External fixation showed superiority over volar locked plating after 1 year of surgery. LEVEL OF EVIDENCE: IV.”
“Irrespective of the direction and amount of initial displacement, a great majority of intra-articular fractures of the distal radius can be managed with a fixed-angle volar plate through a single volar approach. Level IV retrospective case series.”
Use of a distraction plate for DRF with metaphyseal and diaphyseal comminution  (Ruch et al., JBJS 2005)

• The distraction plate combined with reduction of the articular surface and bone-grafting when needed

• Fractures of the distal end of the radius with extensive metaphyseal and diaphyseal comminution.

• A functional ROM with minimal disability can be achieved despite a prolonged period of fixation
96 patients > 60 yo with malunion

High-activity participants with a distal radius malunion were compared to high-activity participants with well-aligned fractures.

“Even among highly active older adults, distal radius malunion does not impact functional outcomes. Judicious use of operative management is warranted provided heightened complication rates.”
“The operative fixation rate for distal radius fractures in the Medicare population continues to rise, with a significant trend toward open fixation. Charges and payments associated with open treatment are significantly higher than those for percutaneous fixation.”

“Malunion of the distal radius does not influence the functional outcome of independent superelderly (>80) patients”
THE EVIDENCE

- CONFUSING
- CONTRADICTORY
- CONFOUNDING
Distal Radius Fracture

Treatment does matter and must address:

• Patient-centric care
  ➢ Appropriate outcomes
• Surgeon bias and conflict of interest
• Device-driven management
• Medical-legal concerns
When TO operate?

When it is appropriate

If you are comfortable with a probable good to excellent outcome and can provide the “best” option

If you are prepared for all eventualities and would have a loved cared for by you
When NOT to operate?

Because the patient is there...

Because of the last talk you attended..

If the patient and your expectations differ

If you cannot deal with the complications effectively ...
Distal Radius Management

Fallacies :

*There is always a best way*

*My patients do not get dystrophies*

**What you can do—**

*Involve the patient*

*Document risks*

*Ask if sleeping at night*

*Beware of stiffness*

*Document you considered CRPS*
References

1 Incidence and characteristics of distal radius fractures in a southern Swedish region. Brogren et al. Musculoskeletal Disorders. 8:48; 2007


3. Analysis of NHSLA claims in hand and wrist surgery. Khan & Giddens. JHS E 35:61-4; 2010

4 Malpractice in distal radius fracture management: an analysis of closed claims. DeNoble ... Glickel. JHS 39:1480; 2014

5 Lawsuit verdicts and settlements involving reflex sympathetic dystrophy and complex regional pain syndrome. Crick & Crick JSOA 20:153-7; 2011

6 The Impact of Patient Activity Level on Wrist Disability after Distal Radius Malunion in Older Adults. Nelson et al J Orth Trauma 2014

7 DRF Complications McKay JHS 26;916-22;2001

8 Geissler et al JBJS 1996

References

10 The role of bone scintigraphy in diagnosing reflex sympathetic dystrophy. Lee G... JHS 20A:458;1995
14 Un-united fractures of the distal radius: a report of 12 cases. Segalman... JHS 23A:914;1998. 2014
References

16 External fixation vs. Plating (Chung JHS 2005)
17 Combined Dorsal and Volar Plate Fixation of Complex Fractures of the Distal Part of the Radius (Ring et al, JBJS 2005)
18 Functional outcome of unstable DRF: ORIF with a volar fixed-angle plate versus ex-fix. (Wright et al, JHS 2005)
18 Functional outcome of unstable DRF: ORIF with a volar fixed-angle plate versus ex-fix. (Wright et al, JHS 2005)
20 Use of a distraction plate for DRF with metaphyseal and diaphyseal comminution (Ruch et al., JBJS 2005)
Thank You