Current Concepts in the Management of Distal Radius Fractures

Daniel A. Rikli, MD
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History Class...
History Class…

- The years before 2000: increasing dissatisfaction…
History Class…

• The years before 2000: increasing dissatisfaction…

• The years 2000: paradigm shift…
History Class…

• The years before 2000: increasing dissatisfaction…

• The years 2000: paradigm shift…

• The years 2010+: the pendulum swings back…
• Conservative treatment
  • Closed reduction/cast
  • Pins & Plaster

...before 2000
• Conservative treatment
  • Closed reduction/cast
  • Pins & Plaster

> High rates of unsatisfactory results

...before 2000
A2.3/A3.3 („Colles“)

Reposition

Retention
Telescoping
Extraarticular Malunion

dorsal overload

Ulnar abutment

adaptive DISI

DRUJ incongruency
Extraarticular Anatomy

- Radial Angle

Radial Length

Palmar Inclination
Articular Malunion

Step off/ Gap > 2mm: painful arthritis radiocarpal joint
Distal Radio-Ulnar-Joint

Knirk & Jupiter, JBJS 1989
External Fixation (bridging)

- Stiffness, Algodystrophy
- Sec. Displacement
- Infection
- Nerve injury
Bone graft

3M
Conventional implants (non-locking)
Problem List

- high rate of unsatisfactory results w/ cons. treatment
- high rate of failures and complications w/
  - Pins & Plaster
  - External fixator
  - Standard plating systems and techniques
- increasing demands of patients re function and cosmesis
- increasing age / osteoporosis
Gain in Knowledge in the 1990ies

- better understanding of
  - Biomechanics, load transmission
  - Pathomechanics
- new implant generation (locking plates)
- modified surgical approaches
- clear and structured algorithms
Three Column Theory

- radial column
- intermediate C.
- ulnar Column

Rikli DA, Regazzoni P, JBJS 1996
Dorsal Double Plating - Biomechanics

Peine, Rikli, Hoffmann, Regazzoni: JHS 2000
Dorsal Double Plating Anatomy

3.5

2.0
**Force Transmission**

<table>
<thead>
<tr>
<th>Method</th>
<th>Authors</th>
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<tr>
<td>Load Cell</td>
<td>Werner</td>
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<tr>
<td>Load Cell</td>
<td>Trumble</td>
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<tr>
<td>Fuji Film</td>
<td>Blevens</td>
</tr>
<tr>
<td>Cond.Rubber</td>
<td>Hara</td>
</tr>
<tr>
<td>Fuji Film</td>
<td>Short</td>
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<tr>
<td>RBSM</td>
<td>Schuind</td>
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from: Cooney WP; The Wrist. Mosby 1998

Shift of pressure area towards dorsal with wrist extension

Viegas SF et al.; JHS 1987
Force Transmission

Rikli DA et al., JHS 2007
Force Transmission

Rikli DA et al., JHS 2007
Force Transmission

The "NovelRad" Project
Dynamic intraarticular pressure measurement in the radio-ulno-carpal joint in vivo
Daniel A. Rikli, MD, Lucerne, Switzerland (Scientific Consultant, Project Leader)
novel gmbh, Munich, Germany (Sensor Technology)
hausformat gmbh, Aarau, Switzerland (Video Art and Postprocessing)

Patient # 5 right hand - Monday, June 24, 2002
2 Centers of load transmission: scaphoid and lunate

Ulnar center fossa lunaris & Ulna

More forces transmitted through ulnar column than previously thought

No forces transmitted through radial styloid

No dorsal shift of pressure area w/ extension

Rikli DA et al., JHS 2007
Proposed Theory of Load Transmission through the Wrist

Radial Column: **Stability**
- Osseous buttress radialy
- Insertion for stabilising capsular ligaments

Intermediate Column:
**Load Transmission**

Ulnar Column:
**Load Transmission & Stability**
- „Ulnar Pivot“
Pathomechanics

- Bending > Ligamentotaxis
- Shear > Buttress
- Compression > Direct Reduction
- Avulsion > Ligaments
- Complex > Combination
LCP Juxta-Articular Distal Radius Plates

- precontoured
- 2.4 locking screws
- screws at angle of 5° back
- distal positioning
- support articular surface
- no bone graft
Dorsal Plates

Radial Column Plates
- precontoured
- different length
- 2.4mm LCP

Intermediate Column Plates
- 8 right-angle plates
- 4 oblique plates
- 2 T-plates
- 2.4mm LCP
Paradigm Shift

Cons. Ttm

> P&P

> Ex Fix

> ORIF

Wilke M et al, Acta Orthopedica 2013
Displaced Extraarticular Fx (A-types)
Extraarticular Fx
A2.3/A3.3 („Colles“)
Rational for Palmar Plating in „simple Colles‘ Fx“

- Anatomic restoration of radial length
- Early function
- Less radiologic and clinical controls
- Outcome more predictable
- Procedure for P&P, ExFix or Plate idem
Postoperative Rehabilitation

- Early function
- Removable splint for 6 wks (optional)
- No restriction from wk 7
(Partial) Articular Fx (B types)
B1.1/B1.2
P. styloides radii
B2 dorsal Rim
(„Barton‘s“)
Fx Dislocation
- Carpal Subluxation
- Impacted joint surface
- Instability
Rev. Barton Fx

1Y

4M

po

1Y

4M
(Complete) Articular Fx (C-types)
C3, axial compression
C3, axial compression
C3, axial compression
C2, axial Compression
Dorso-ulnar Fragment
C3, axial compression
C3, axial compression
Assoc. Carpal Ligament Tear
C3, axial compression
C3, axial compression
C3, axial compression
C3, axial compression
axial compression
Possible Complications w/ Plating

- Hematoma, infection
- Implant malpositioning
- Sec. displacement
- Tendon injuries
- Stiffness
- Algodystrophy
### Complications w/ Plamar Plating

<table>
<thead>
<tr>
<th>Complication</th>
<th>Count</th>
<th>Percentage</th>
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<tr>
<td>N=</td>
<td>665</td>
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<tr>
<td>complications</td>
<td>75</td>
<td>(11%)</td>
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<tr>
<td>reoperations</td>
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<td>(10%)</td>
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<td>CTS</td>
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<td>ulnar shortening</td>
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<tr>
<td>screw intraarticular</td>
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<tr>
<td>flexor tendon rupture</td>
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<td>compartment sy.</td>
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<tr>
<td>infection</td>
<td>3</td>
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<tr>
<td>CRPS</td>
<td>9</td>
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<tr>
<td>hardware failure</td>
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<tr>
<td>implant removal</td>
<td>232</td>
<td>(34%)</td>
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Esenwein P, Arch Orthop Trauma Surg 2013
Complications w/ Plamar Plating

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
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<tbody>
<tr>
<td>N=</td>
<td>303</td>
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<tr>
<td>complications</td>
<td>18 (6%)</td>
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<tr>
<td>extensor tendons</td>
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<tr>
<td>flexor tendons</td>
<td>4</td>
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<tr>
<td>screw penetration DRUJ</td>
<td>1</td>
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<tr>
<td>loss of reduction</td>
<td>3</td>
</tr>
<tr>
<td>infection</td>
<td>1</td>
</tr>
</tbody>
</table>

«Majority of adverse events … due to technical errors»

Tarallo L et al, JOT 2013
Insufficient Reduction

p.o.
Insufficient Reduction
Inadequate Plate-Positioning
Loss of Reduction
Loss of Fixation
Loss of Reduction
Loss of Fixation
Loss of Reduction Screws
Tendon Problems

- EPL-Ruptur (T. Listeri)
- Direct interference w/ implant (flexors, extensors)
- Dorsal screw penetration (extensors)
Flexor Tendons

- Acumed: n=73, 1 rupture in B, 2 in C (4%)
- Hand Innovations: n=95, no ruptures

Soong M et al, JBJS 2012
Screws

w, 60J

po

6w
Extensor Tendons
...but...the Pedulum swings back
Cognitive Impairment

Malnutrition

Ageing

Fall

Osteoporosis
Clinical Decision Making

- Functional state / demands
- Dependency
- Nutritional state
- Cognitive / Mental state
- (Bone Quality)
- (Fracture Classification)
Goal: Healthy Aging
Today’s algorithm at UHB

- Non-displaced Fx: conservative T.
Today’s algorithm at UHB

- Displaced Fx, *extraarticular*:
  - Palmar (any age): ORIF
  - Dorsal («young», self-dependant): ORIF
  - Dorsal (geriatric, low demand): Plaster
Today’s algorithm at UHB

- Displaced Fx, *articular*:
  - Palmar (any age): ORIF
  - Dorsal («young», self-dependant): ORIF
- Fx-dislocations (B-types): ORIF
- Dorsal (geriatric, low-demand): Plaster
Distal Radius Fx
Restore

Extraart.
Anatomy
Articular
Anatomy
Soft tissue