Corrective Osteotomy of Distal Radius Malunion---New Horizons

- Jesse B Jupiter MD

**WRIST FRACTURES**

**OSTEOARTICULAR COMPLICATIONS**

1. **LOSS OF REDUCTION**
2. **DELAYED UNION AND NONUNION**
3. **MALUNION**
4. **DISTAL RADIOULNAR JOINT**

**ASSOCIATED LESIONS**

- Carpal ligaments
- Carpal fractures
- Nerves
- Tendons
- Combined soft tissues
- Vascular, compartment syndrome

**COMPLICATIONS**

- Carpal instability
- Nonunion, malalignment
- Neuropathy
- Tendinitis, ruptures
- Multifactorial functional deficit
- RSD, Complex Regional Pain syndrome

**Disclosures**

I certify that, to the best of my knowledge, no aspect of my current personal or profession situation might reasonably be expected to affect significantly my views on the subject on which I am presenting.

- Consultant Trimec Co
- Stock AO Foundation
- Research OHK Co
- Reviewer Elsevier; Springer; Walter Klauer
- Editor Walter Klauer
- Committees AAHS; ASSH; AAOS

- All images in presentation are my own
TIMING OF SURGERY
as soon as possible, provided there is:
- absence of trophic changes
- acceptable bone quality
- adequate wrist function

NASCENT MALUNION
- immature callus
- established deformity (5 – 8 weeks post-fracture)

MATURE MALUNION
- remodelled callus
- 4 to 6 months or more post-fracture

ADVANTAGES OF EARLY CORRECTION
• easiness of radial and DRUJ re-alignment
• less soft tissue contractures and DRUJ dysfunction
• no need of structural corticocancellous bone graft
• considerably decrease of total disability
• early return to work


SURGICAL TECHNIQUE

**corrective osteotomy of malunited Colles fractures through a dorsal approach**

preoperative planning is based on the radiographic measurements of the opposite wrist:
- ulnar inclination
- ulnar variance
- volar tilt

(for rotational deformity: comparative CT-scans)

preoperative planning
dorsal approach

2.4 distal radius locking plates
**FINITE CENTER OF ROTATION**

- draw contours of respective projections
- connect corresponding landmarks
- draw perpendicular lines through midpoint
- intersection = FCoR

**INCOMPLETE OSTEOTOMY**

- FCoR at bone margin
INCOMPLETE OSTEOTOMY
- FCoR at bone margin
- osteotomy through FCoR

INCOMPLETE OSTEOTOMY

INCOMPLETE OSTEOTOMY
- FCoR at bone margin
- osteotomy through FCoR
- opening / closing wedge
- length changes
- no rotational changes

ROCKING OSTEOTOMY
- FCoR within bone contours
ROCKING OSTEOTOMY

- FCoR within bone contours
- osteotomy through FCoR

COMPLETE OSTEOTOMY

- FCoR outside bone contours
- lengthening
- shortening
- rotation possible
correction of malunited Colles’ fractures through a volar approach:

- Open wedge osteotomy, interpositional bone graft and volar plate fixation (U. Lanz, J. Orbay)
- Close wedge osteotomy, Darrach procedure and K-wire fixation (Posner, Garcia-Elias)
- Close wedge osteotomy and ulnar shortening
- Close wedge osteotomy and ulnar head prosthesis (D.L. Fernandez)
CORRECTION IN FRONTAL PLANE

CORRECTION IN FRONTAL PLANE

CORRECTION IN SAGITTAL PLANE

CORRECTION IN SAGITTAL PLANE
SCREW LENGTH ≈ ANGLE

- hole   screw length in mm
- 6  8  10  12  14  16  18  20  22
- 3  10  14°  18°  22°  26°  30°  33°  36°  39°
- 4  7°  11°  14°  17°  20°  23°  26°  28°  31°
- 5  6°  8°  11°  14°  16°  18°  21°  23°  25°
open wedge osteotomy, bone graft and volar plate fixation


CONVENTIONAL PLANNING

- Shortcomings / Problems:
- assessment of rotation
- correction of volar tilt angulation influences the ulnar inclination
- Reference changes with 3-D deformity
- assessment of intraarticular malunion
3-dimensional image acquisition and 3-D planning

Osteotomy Report
Cutting: 22.014 mm (from distal) to proximal
Cut is performed at 22.014 mm (from distal)
Osteotomy result:
First: Rotation around axis 2 by 15.868 degrees
Second: Rotation around axis 1 by 26.756 degrees
Third: Rotation around axis 0 by 9.2067 degrees
Fourth: Translation by 0.93842 (axis 0), 0.7939 (axis 1), -11.642 (axis 2) mm
Osteotomy result:

First: Rotation around axis 2 by 3.2372°
Second: Rotation around axis 1 by -15.076°
Third: Rotation around axis 0 by -7.8848°
Fourth: Translation by 0.33353 mm, 0.66308 mm, -4.9765 mm
**CASE EXAMPLE**

**INTRAARTICULAR MALUNION**

Intra-articular malunion results after failure to recognize potentially unstable articular disruption, or insufficient reduction and fixation during surgical treatment.
The indication of osteotomy for an intra-articular malunion depends on:

1) the fracture pattern
2) the extent of cartilage damage
3) the chronology
4) presence of fixed carpal malalignment
5) the soft tissue condition
CONTRAINDICATIONS

1) severe cartilage damage
2) radiographic degenerative changes
3) chronic synovitis
4) significant soft tissue and capsular contractures (post RSD)
5) complex fracture pattern and fixed carpal malalignment

TREATMENT RECOMMENDATIONS

- simple intra-articular disruption
- as soon as possible
- minimal cartilage damage (chondromalacia)
- adequate pre-operative function
- compliant, cooperative patient

otherwise a limited carpal fusion (RSL or RL) is preferable
ARTHROSCOPIC ASSISTED TREATMENT OF DISTAL RADIUS MALUNION


 Courtesy: Dr Francisco del Piñal, Santander, Spain
Combined Intra- and Extra-Articular Distal Radius Malunion

- Corrective osteotomy → Effective
- Technically challenging
Corrective Osteotomy for Combined Intra- and Extra-Articular Distal Radius Malunion

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Study Aims

- Previous case series:
  - Intra-Articular (Ring, Fernandez, Prommersberger, Jupiter 2005)
  - Extra-Articular (Fernandez 1982, Jupiter & Ring 1996)
  - Isolated Intra- and Extra-Articular (Lozano 2009)

- This case series:
  - Combined Intra- and Extra-Articular Malunion

Methods

Patient Inclusion

- Inclusion criteria:
  - Combination of:
    - extra-articular deformity ($\geq 10^\circ$ angulation)
    - intra-articular incongruity of $\geq 2$mm (max step-off or gap)
- Exclusion criteria:
  - Time from injury >3 month
  - Time to FU < 6 months
Methods

Patient Inclusion

- Period 1998-2009:
  - 20 consecutive patients
- 4 institutions:
  - MGH (Boston, USA)
  - Rhön-Klinikum (Bad Neustadt an der Saale, Germany)
  - Santa Cristina University Hospital (Madrid, Spain)
  - Lindenhof Hospital (Bern, Switzerland)
- Lost to FU: 3 pts

→ 17 pts evaluated at ±4 years (0.5-11)

Methods

Patient Characteristics

- 8F, 9M ± 48.8 years (19-67)
- Time from injury: ± 11 months.
- Max step-off or gap: ± 4.0 mm
- Dominant hand (6/17): 35%

Surgical Technique

Extra-Articular Malunion

Surgical Technique

Intra-Articular Malunion
Surgical Technique

[Images of medical scans and illustrations showing surgical techniques]
CONCLUSIONS

- malunion remains the most common complication of closed reduction and plaster immobilisation of unstable extra-articular fractures

- intra-articular malunion results after failure to recognize potentially unstable articular disruption, or insufficient reduction and fixation during surgical treatment

- if symptomatic extra-articular malunion occurs, radial osteotomy offers better function, improves the external appearance and normalizes carpal kinematics

CONCLUSIONS

-intra-articular malunion deserves early correction in order to restore the functional – anatomic integrity of the joint before the onset of symptoms and cartilage damage

-our experience has shown that with:

  careful patient selection
  correct indication and
  refinements of surgical technique

over 80% of excellent and good results can be expected

CONCLUSIONS

Complications and failures are commonly caused either by technical errors, or by improper patient selection with:

  degenerative changes
  trophic disturbances
  partial joint stiffness
  severe osteoporosis
  fixed type of DISI malalignment

and failure to assess and simultaneously treat associated disorders of the distal radioulnar joint
CONCLUSIONS

- osteotomies reliably improve function and relieve pain
- preoperative planning and meticulous operative technique are fundamental
- novel techniques may reduce morbidity, improve precision of correction and end result

THANK YOU