Nonunion of the Fractured Scaphoid

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Disclosure
I have no financial conflicts to disclose
Scaphoid Fractures

- The majority of scaphoid fractures heal with non-operative treatment
- Case series report a ~10% nonunion rate
- #1 risk factor for scaphoid nonunion is fracture displacement
Other Risk Factors for Nonunion

- Failure to seek medical attention/delayed diagnosis
- Proximal Pole Fractures
- Inadequate Immobilization
- Presence of AVN
- Associated carpal instability
The Natural History of Scaphoid Non-Union*

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Fig. 3-A
Fig. 3-B

Fig. 3-A: In Group I, non-unions demonstrated cystic, resorptive changes or sclerosis at the fracture margins. Fig. 3-B: A Group-I scaphoid non-union with cystic resorption. Note the absence of degenerative changes in the radioscaphoid joint.
Fig. 4-A: Group-II non-unions are characterized by degenerative changes in the radioscapoid joint.

Fig. 4-B: Note the pointing of the radial styloid. The distal fragment is displaced and appears on this roentgenogram to abut the styloid.

Fig. 5-A: Group-III non-unions are characterized by degenerative arthritis throughout the wrist.

Fig. 5-B: In addition to generalized arthritis there is radial migration of the distal carpal row. Apparent carpal collapse was not significant in this patient, but carpal collapse or radial shift of the distal row, or both, were found in more than half the Group-III wrists.
30 year old scaphoid nonunion
Symptoms of Scaphoid Nonunion

- Many patients present years after fracture
- Loss of motion
- Decreased grip strength
- Dorsal wrist swelling
- Localized tenderness or pain at extremes of motion
CT scan to assess anatomy

- Best CT images if obtained in planes defined by long axis of scaphoid
- Pt lies prone with arm overhead, forearm pronated
Correction of Deformity

- In general, correction of a deformity necessitates a volar approach
- Humpback deformity
  - Increased lateral intrascaphoid angle (>45°)
  - Abnormal radiolunate angle (>15°)
Goals of Scaphoid Nonunion Surgery

- Achieve union
- Restore anatomy
- Improve symptoms
- Limit arthrosis
MRI to Assess Vascularity

Correlation with punctate bleeding or pathology

Standard MRI

MRI w/ Gadolinium
  – More accurate
  – Ranges 83%-94.3%
MRI to Assess Vascularity

Does MRI accurately diagnose AVN?

Does AVN prevent union if a nonvascularized bone graft is used?
Scaphoid Nonunion

- 17 year old soccer goalie
- Pain after catching a driven ball
- No deformity issue
- Questionable vascularity
- Dorsal Approach
Scaphoid Nonunion
Distal Radius Bone Graft-Dorsal Approach
Scaphoid Nonunion
18 yo HS football player
Volar Approach
Iliac Crest Strut Graft
Iliac Crest Strut Graft vs. Cancellous
Treatment of Scaphoid Nonunions: Quantitative Meta-analysis
Merrell, JHS 2002

- Screw Fixation higher union rate than K-wires
- Younger patients higher union rates
- Immediate vs. delayed mobilization- no apparent difference in union rates
- Avascular necrosis proximal fragment
  - Vasc graft (88% union) versus screw with wedge fixation (47%)
Additional Prognostic Factors

- Failed previous surgery
- No punctate bleeding of proximal pole
- Location
  - Distal, near 100% rate of union
  - Waist, 85% (waist versus distal, p = .02)
  - Proximal pole 67% (waist vs proximal, p < .00001)
Vascularized Bone Grafting

- Distal Radius
  - 1-2 intercompartmental artery pedicle
  - Dorsal capsule
- Free iliac crest
- Free rib
- Free distal femur
The Outcomes and Complications of 1,2-Intercompartmental Supraretinacular Artery Pedicled Vascularized Bone Grafting of Scaphoid Nonunions

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Chang et al, JHS 2006

• 47 pts (9 female, 38 male); avg age 24
• 34 united at avg 15.6 weeks
• Complications (8)
  – Graft extrusion
  – Superficial infection
  – Deep infection,
  – Failure of fixation
Risk factors for failure
- Older age
- Proximal pole AVN
- Pre-op humpback deformity
- Non screw fixation
- Tobacco use
- Female gender
Free Vascularized Grafting
Salvage Options

• Proximal row carpectomy
• Scaphoid excision intercarpal fusion
• Wrist arthrodesis
• Distal scaphoid resection arthroplasty
Distal scaphoid resection arthroplasty for the treatment of degenerative arthritis secondary to scaphoid nonunion
Maleriche et al, JHS 1999

• 19 pts, all with DISI (10% loss carpal height, RL angle -32°), avg age 40
• Avg 12 year duration nonunion
• f/u mean 49 months
• ROM ↑85% grip ↑134%
• 13 (68%) complete pain relief
Figure 1. Before surgery. In an ideal case the proximal scapholunate-capitate articulation is spared of arthritis (1 and 2) and the arthritic changes are present between the distal scaphoid fragment and the capitate and radial styloid (3 and 4).

Figure 2. A postoperative radiograph showing maintenance of the midcarpal articular surface at 4 years.
Results
Soejima et al, JHS 2003

- 4 no wrist pain, 5 mild pain with strenuous activity
- ROM: 70 (51.4%) to 140 (94%)
- Grip strength: 18 kg (40%) to 30 kg (77%)
- Modified Mayo: 6 excellent, 3 good
- No progression of DJD (*1 pt with type II lunate developed DJD at proximal scaphounte capitate articulation)
Conclusions

• The management of scaphoid fracture nonunion is complex
• Imaging modalities such as contrast enhanced MRI and CT scans can sometimes be helpful with pre operative planning
• There is still debate with respect to the use of nonvascularized bone grafting, vascularized bone grafting, and salvage procedures in the treatment of these nonunions
Thank You