

Complications after scaphoid fracture surgery

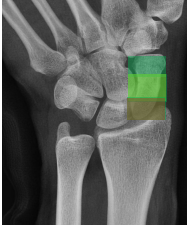
Dr Joris Duerinckx

BVOT - BHG, 26/4/2019

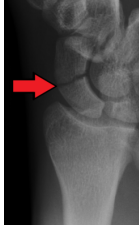
Orthopedisch Centrum Limburg
DEPARTMENT OF HAND SURGERY

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Scaphoid fracture treatment




- ▶ Distal pole fracture conservative
- ▶ Undisplaced waist fracture conservative vs surgery
- ▶ Proximal pole fracture surgery



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Undisplaced scaphoid waist fracture



Trend toward surgical fixation

- Buijze, JBIS Am 2010
- Ibrahim, JHS Am 2011
- Bond, JBIS Am 2007
- Arora, Arch Orthop Trauma Surg 2007

▶ Surgical treatment / Immobilisation
→ healing rate 88 - 95% (Cooney WP et al. CORR 1980)

▶ Surgery → decreased time off work

Treatment type	Conservative	OSF
Bone healing	12 weeks	7 weeks
Returns to sports	15 weeks	8 weeks

▶ Surgery → higher complication rate

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Possible complications after scaphoid fracture surgery

Study	Year	N	% OSF	Approach	Complication Rate	Complications
Wolfe and Gault ¹⁷	1991	49	100	Distal	9.1%	Distal Union
Holbrook and Gault ¹⁸	1996	15	100	Distal	7.3%	Distal Union, Dorsal Union
Andriessen ¹⁹	2001	28	96	Distal	40.7%	Proximal Union, Dorsal Union, Nonunion
Bond ²⁰	2001	11	100	Distal	9.1%	Proximal Union, Dorsal Union
Nguyen ²¹	2002	48	100	Distal	6.3%	Nonunion
Scaph ²²	2003	19	100	Distal	0.0%	None
Nguyen ²³	2003	48	100	Distal	0.0%	None
Yip ²⁴	2003	11	100	Distal	0.0%	None
Chang ²⁵	2003	11	100	Distal	0.0%	None
Shaw ²⁶	2003	26	96	Distal	4.2%	Nonunion
Chang ²⁷	2005	11	100	Distal	0.0%	None
Shaw ²⁸	2005	14	100	Distal	0.0%	None
Shaw ²⁹	2005	26	96	Distal	4.2%	Nonunion
Preussner ³⁰	2005	11	100	Distal	0.0%	None
Shaw ³¹	2005	15	100	Distal	0.0%	None
Shaw ³²	2005	15	100	Distal	14.3%	Nonunion
Wong ³³	2005	7	100	Distal	0.0%	None
Arora ³⁴	2005	32	96	Distal	0.0%	None
Arora ³⁵	2006	11	91	Distal	18.2%	Nonunion, Proximal Union, Distal Union
Bond ³⁶	2007	16	94	Distal	6.3%	Nonunion
Woolhage ³⁷	—	—	—	—	—	Nonunion, Proximal Union, Distal Union

Complication rates

- volar approach 0 - 30%
- dorsal approach 0 - 29%

Nonunion = most common complication

B. Bushnell et al., J Hand Surg Am 2007

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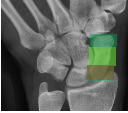

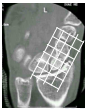
Scaphoid nonunion: diagnosis

- Time for healing
 - 6 weeks
 - 6-12 weeks
 - 3-6 months
- Cheung GC, Lever CJ, Morris AD, J Hand Surg Am 2006

Radiographic healing is defined as the lack of a visible radiolucent fracture line on any one of a minimum of 4 views of the scaphoid

- Mallee, JBIS Am 2011

CT-scan with reconstructions defined by the long axis of the scaphoid

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How to optimize bone healing after scaphoid fracture surgery

1. Screw length
2. Screw diameter
3. Screw placement
4. Fracture compression
5. Approach

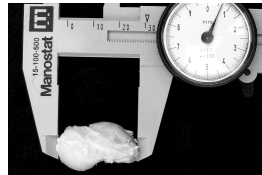


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How to optimize bone healing after scaphoid fracture surgery

1. Maximize screw length

- Scaphoid length (Meermans, CORR 2012)
 - Male: 27,14 ± 0,97 mm
 - Female: 23,86 ± 0,37 mm
- Screw length 20-22 mm



How to optimize bone healing after scaphoid fracture surgery

2. Appropriate screw diameter

- Scaphoid width (Heinzelman, J Hand Surg 2007)
 - Male scaphoid is significantly wider than female specimen at proximal pole and at waist.
- 'Standard' screws are often larger than the proximal pole of the female scaphoid.
- 'Micro' screws when antegrade insertion (dorsal approach).

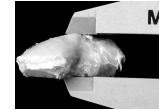
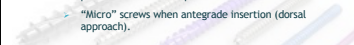


Table 2. Scaphoid Measurement Results for Male and Female Specimens With Standard Deviations and Corresponding p Values

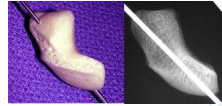
	Length (mm)	Proximal Width (mm)	Distal Width (mm)	Waist Width (mm)
Male	31.3 ± 2.1	4.5 ± 1.4	7.2 ± 1.0	13.6 ± 2.6
Female	27.1 ± 1.7	3.7 ± 0.5	7.2 ± 1.2	11.1 ± 1.2
p value	<.001	.001	.879	<.001



How to optimize bone healing after scaphoid fracture surgery

3. Correct screw placement

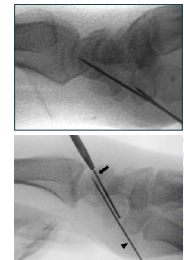
- Along central scaphoid axis
 - Dodds et al. JHS Am 2006
 - McCallister WV et al. JBJS Am. 2003)
- Perpendicular to fracture line
 - Jeon IH et al. JHS Am. 2009



How to optimize bone healing after scaphoid fracture surgery

4. Approach

- Volar (retrograde) approach
 - Difficult central screw placement in the distal pole (Chan KW, McAdams TR. JHS Am 2004)
 - Consider removing palmar piece of trapezium or transtrapezial approach (Meermans et al., JHS Am 2011)
- Dorsal (antegrade) approach
 - Allows screw placement
 - more central in the scaphoid (Jeon, J Hand Surg 2009)
 - more perpendicular to the fracture line (van Berg et al., Orthopaedics & Traumatology, Surgery & Research 2018)

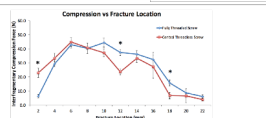
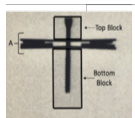
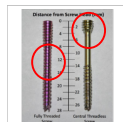


→ no difference in healing rate

How to optimize bone healing after scaphoid fracture surgery

5. Maximize compression

- Headless compression screw
- Variable pitch → interfragmentary compression
 - Fully threaded: central
 - Central threadless: at screw head



Patel S, et al. Hand, 2017

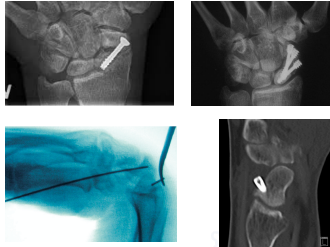
Other possible complications after scaphoid fracture surgery

- Hardware problems
- Avascular necrosis
- Tendon irritation or tendon rupture
- Nerve injury
- Vascular injury
- Superficial wound infection
- Prolonged wound drainage (>5 days)
- Septic arthritis



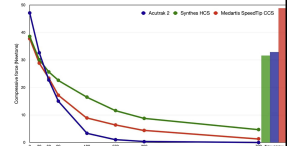
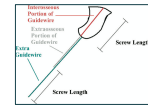
Hardware problems

- ▶ Inappropriate type of screw
- ▶ Incorrect screw placement
- ▶ Number of screws
- ▶ Guidewire breakage
- ▶ Screw breakage
- ▶ Screwdriver breakage



Hardware problems

- ▶ **Screw to long**
 - ▶ Measured length - 4 mm (Bushnell B et al, J Hand Surg Am 2007)
 - ▶ Confirm this number using a parallel-guidewire technique (Bedi A et al. J Hand Surg Am 2007)
 - ▶ Avoid screw reverse turning! (Donald S et al, J Hand Surg Am 2018)
 - ▶ Replace with a screw of greater diameter
 - ▶ → greater reinsertion compressive force than that achieved after 30° of reverse turning of the initial screw.



Hardware problems

▶ Intra-articular screw placement

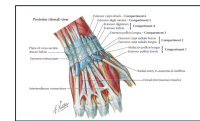
- ▶ STT joint
 - ▶ Radiographic control: A pronated oblique view, combined with ulnar deviation and 45° of flexion of the wrist, best allows evaluation of the STT joint
- ▶ Radio-scaphoid joint
- ▶ Scapho-capitate joint
 - ▶ Avoid eccentric screw placement (McCallister et al, JBJS Am, 2003)



Tendons - nerves - blood vessels

▶ Percutaneous dorsal approach can place several structures at risk (Adamany DC et al. J Hand Surg Am. 2008)

- ▶ 2.2 mm from PIN
- ▶ 3.1 mm from the EIP, through EIP 1/6
- ▶ 5.1 mm from EPL, through EPL 1/6
- ▶ 17.4 mm from the superficial branch of the radial nerve
- ▶ My preferred technique: mini-open



- ▶ Volar approach
 - ▶ Radial artery
 - ▶ Superficial branch of the radial nerve
 - ▶ Recurrent branch of the median nerve

Degenerative arthritis

▶ Dorsal (antegrade) approach

▶ ?

▶ Palmar (retrograde) approach

- ▶ No higher chance of STT degenerative changes with transtrapezial approach (Geurts G et al, J Hand Surg Am 2011)



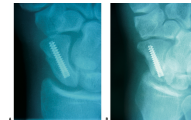
Avascular necrosis

Delayed scaphoid proximal pole AVN after surgery of undisplaced scaphoid waist fracture ?

2 cases

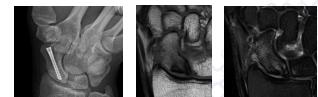
1. B. Bushnell et al, JHS Am 2007

- ▶ 30 y.o. man, percutaneous antegrade fixation with Acutrak standard screw. Fracture healed at 8 weeks.
- ▶ At 11 months after surgery he still complained of pain and stiffness in the wrist. Radiographs showed a fracture of the proximal pole of the scaphoid. Patient refused further treatment.
- ▶ The exact cause of this fracture remains unclear. Perhaps the fracture was due to unrecognized avascular necrosis of the proximal pole caused by the STT.



2. My own experience

- ▶ 34 y.o. man, percutaneous retrograde fixation with Acutrak mini screw. Uneventful bone healing.
- ▶ At 8 months after surgery sudden pain development.
- ▶ RI screw removal + wrist arthroscopy, softened subchondral bone plate, but stable cartilage.
- ▶ 5 months later no more pain, slightly decreased wrist ROM.
- ▶ MRI



Conclusion

Operative treatment of acute scaphoid fracture

- ▶ Can be succesfull procedure
- ▶ Be aware of possible pitfalls
- ▶ Tips & tricks



Thank you

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