

July 31, 2017

Scaphoid Humpback Deformity—A Static or Dynamic Problem?

Paul Willem Louis ten Berg

PhD Candidate

Department of Plastic, Reconstructive, and Hand Surgery, Academic Medical Center, Amsterdam, The Netherlands

Other Contributors:

Marieke Geertruida Aleida de Roo

PhD Candidate

Department of Plastic, Reconstructive, and Hand Surgery, Academic Medical Center, Amsterdam, The Netherlands

Simon Dante Strackee

Plastic surgeon

Department of Plastic, Reconstructive, and Hand Surgery, Academic Medical Center, Amsterdam, The Netherlands

Scaphoid waist fractures are notorious for nonunion, which often shows a typical humpback deformity as a result of persisting fracture instability. Correcting a humpback deformity is challenging because of the complex and 3-D nature of fragment malalignment [1,2] and the associated palmar bone defect at the fracture sites [3]. To reach consensus about the optimal reconstructive technique, reliable imaging tools are needed to evaluate malalignment and reconstructed morphology.

In their study, Schwarcz et al. investigated the humpback deformity in acute scaphoid fractures (within 6 weeks after injury) using 3-D CT-based imaging techniques. The position of the proximal and distal segments in 23 displaced scaphoid fractures was quantified and compared with those in 57 nondisplaced scaphoid fractures and in 27 healthy scaphoids. In the displaced fractures, the authors found no significant motion of the distal fragment, only of the proximal fragment, which mainly extends and supinates, explaining the deformity.

We appreciate the authors' efforts to develop 3-D imaging tools. To analyze deformity, they used clearly

defined anatomical landmarks in a coordinate system based on the distal radius. We have, however, two fundamental concerns with the study's conclusions in relation to the applied methodology.

Firstly, the authors concluded that in acute scaphoid fractures only the proximal fragment actually moves and it is this fragment that should be reduced. This conclusion, however, was based on unstandardized CT images of the wrist in neutral posture only, which hampers ruling out pathological movement of the distal fragment in other wrist postures. Previous research investigating the in vivo radiocarpal kinematics in 28 healthy wrist pairs showed that the scaphoid primarily flexes or extends in all directions of wrist motion [4]. Thus, to fully understand the magnitude of fragment motion, a carpal kinematic dataset for the full range of wrist motion is required. This can be done by either taking images of multiple static wrist postures or by taking images during a continuous dynamic wrist motion [4]. Moreover, it seems unlikely that a static posture of the wrist during imaging resembles the wrist postures during surgery, which is usually either extended (palmar approach) or flexed (dorsal approach). This hampers extrapolating biomechanical data to clinical settings.

Secondly, three previous studies [1,2,5] showed a more complex displacement pattern with involvement of both fragments in older scaphoid fractures (average time after injury: 6 to 9.5 years). Moritomo et al. [1] analyzed fragment motion in 13 scaphoid nonunions using static images of the wrists in 5 postures. Unstable fractures with the wrist in a flexed posture showed a relatively flexed distal fragment ("book-closing" motion), compared with stable fractures. Oka et al. [2] demonstrated a dorsal translation of the unstable distal fragment in addition to extension of the proximal fragment, using single static images of 20 scaphoid nonunions. Lastly, in a small series of 6 scaphoid nonunion patients using images of the wrist in 9 different postures, Leventhal et al. [5] showed that the proximal fragment can either be relatively flexed or extended depending on wrist posture, due to uncoupling of the carpal rows. The conclusion of Schwarcz et al. that "the typical humpback deformity is actually a proximal extension deformity" seems to underestimate the complexity of the deformity and the surgical correction required to restore the normal anatomy in older scaphoid fractures.

Despite the aforementioned limitations, the study of Schwarcz et al. is valuable for our understanding of the behavior of unstable scaphoid fractures, especially of the temporal sequence. When synthesizing the kinematic observations in literature, the development of a humpback deformity seems to start primarily with extension of the proximal fragment (together with the lunate), followed by displacement of the distal fragment including dorsal translation when the fracture is left untreated. We would therefore recommend

using the term “early stage” instead of “typical” when describing the humpback deformity in acute scaphoid fractures.

The exact consequences of unstable scaphoid fractures on interfragmentary motion and carpal kinematics remain under debate. Future studies should clearly distinguish between dynamic imaging and semi-dynamic (static) imaging techniques, since conclusions derived from static data are unable to resolve true dynamic problems of the wrist.

References

1. Moritomo H, Murase T, Oka K, Tanaka H, Yoshikawa H, Sugamoto K. Relationship between the fracture location and the kinematic pattern in scaphoid nonunion. *J Hand Surg Am*. 2008 Nov;33(9):1459-68.
2. Oka K, Moritomo H, Murase T, Goto A, Sugamoto K, Yoshikawa H. Patterns of carpal deformity in scaphoid nonunion: a 3-dimensional and quantitative analysis. *J Hand Surg Am*. 2005 Nov;30(6):1136-44.
3. Oka K, Murase T, Moritomo H, Goto A, Sugamoto K, Yoshikawa H. Patterns of bone defect in scaphoid nonunion: a 3-dimensional and quantitative analysis. *J Hand Surg Am*. 2005 Mar;30(2):359-65.
4. Crisco JJ, Coburn JC, Moore DC, Akelman E, Weiss AP, Wolfe SW. In vivo radiocarpal kinematics and the dart thrower's motion. *J Bone Joint Surg Am*. 2005 Dec;87(12):2729-40.
5. Leventhal EL, Wolfe SW, Moore DC, Akelman E, Weiss AP, Crisco JJ. Interfragmentary motion in patients with scaphoid nonunion. *J Hand Surg Am*. 2008 Sep;33(7):1108-15.

Conflict of Interest: None Declared