CT Scans Oriented Along the Longitudinal Scaphoid Axis Do Not Change Surgical Management of Scaphoid Fractures

Introduction
It is imperative that the correct patients with scaphoid fractures to offer surgery to be identified, as some scaphoid fractures can be managed non-operatively. CT scans can be useful because they allow surgeons to make precise measurements. For example, CT scans can be used to measure whether >1mm of displacement is present, which is often a surgical indication. CT scans are more accurate than plain radiographs in determining the degree of fracture displacement but operative treatment is being offered with greater frequency to active patients as an approach to reduce the period of cast immobilization. Computed tomography is more useful for evaluating displacement than standard radiography. Displaced fractures are at greater risk for nonunion and malunion—both of which have been associated with the development of radiocarpal arthritis in long-term studies—and should therefore be treated operatively. Surgical treatment is also recommended for complex fractures (open fractures, perilunate fracture-dislocations, and scaphoid fractures associated with fracture of the distal radius) and can also be used to make more specialized measurements such as height-to-length ratios and intra-scaphoid angles.

Reformatting CT scans along the long axis of the scaphoid improves the detection of scaphoid fractures. However, it is unclear whether these reformatting affects the clinical decision to perform open reduction internal fixation (ORIF). Our null hypothesis was that assessing scaphoid fractures in the longitudinal scaphoid axis would not lead to different surgical recommendations than those from those made from the wrist axis.

Methods
After obtaining IRB-approval, we retrospectively identified 30 patients using an online database (Montage Healthcare Solutions, Nuance Communications Inc.) of radiology reports with acute scaphoid fractures. All enrolled patients were identified from one institution. All identified CT scans were removed of patient identifiers. Each CT scan was then re-formatted along the longitudinal axis of the scaphoid using the TeraRecon™ software system. These reformatting were then compared against the wrist axis CT scans.

The anonymized scaphoid axis and wrist axis CT scans were evaluated by two musculoskeletal radiologists and two board-certified orthopedic hand surgeons. Each specialist independently read the CT scans in a random, blinded fashion. On each CT scan, the following measurements were made: fracture gap, displacement of articular surface, intrascaphoid angle, and height-to-length ratio. To assess our null hypothesis, each scaphoid CT was assigned a designation of "Requires Surgery" if any one of the following cutoffs was met: fracture gap >1mm, articular displacement >1mm, intrascaphoid angle >35°, or height-to-length ratio >0.65. The determination of surgery based on wrist versus scaphoid axes was then compared using McNemar's test and a p value was calculated.

Results
87% of the fractures evaluated resulted in the same surgical recommendations on both the scaphoid and wrist axis, while 13% resulted in discordant surgical recommendations. To determine whether these differences were statistically significant, the McNemar's test was used. A two-tailed p value of 0.21 was obtained, demonstrating no statistical significance.

Discussion
We failed to reject our null hypothesis that reformatting CT scans along the scaphoid axis would lead to different surgical recommendations. We used very specific cutoffs to determine which patients would be offered surgery and we acknowledge that not all hand surgeons would ascribe to these exact parameters. However, demonstrating that measurements of scaphoid fracture displacement and deformity do not differ depending on CT formatting is important. While exact cutoffs for individual surgeons may differ, our study indicates that the measurements are not affected.

There are several limitations to this study. Chief among these limitations is that we analyzed only thirty scaphoid fractures, which makes our study prone to a type II error, especially given that no differences were found.

Additionally, making the above measurements of displacement and deformity are also subject to variability based on the clinician making the
measurements and which specific CT slice they choose. More studies are needed to determine the best technique or CT slice for making these measurements.

References


