SCIENTIFIC ARTICLE

Changes in Wrist Motion After Simulated Scapholunate Arthrodesis: A Cadaveric Study

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Purpose A high incidence of nonunion and relatively poor outcomes with prior fixation techniques has precluded scapholunate (SL) arthrodesis as a standard treatment for SL instability. Our purpose was to determine the impact on range of motion (ROM) of simulated SL arthrodesis via headless screw fixation.

Methods We performed baseline wrist ROM for 10 cadaveric wrists using a standardized mounting-and-weights system. Extension, flexion, radial deviation, ulnar deviation, dart-thrower's extension, and dart-thrower's flexion were assessed. Two 3.0-mm headless compression screws were inserted across the SL joint to simulate SL arthrodesis. Goniometric measurements and fluoroscopic imaging were repeated to assess ROM differences after simulated SL arthrodesis. We assessed SL angle and gap during testing to ensure there was no significant motion between the scaphoid and lunate, thus confirming stable simulated fusion. Differences in ROM were compared between baseline and simulated SL arthrodesis using paired *t* tests.

Results Mean SL angle remained constant between pre- and post-arthrodesis imaging (47° ± 6° vs 46° ± 4°) and did not change during post-arthrodesis ROM testing, indicating a stable simulated fusion. Compared with baseline, SL arthrodesis had a statistically significant reduction in maximum flexion of 6° and 9° based on fluoroscopy and goniometry, respectively, in dart-thrower's extension of 5° and 9° based on fluoroscopy and goniometry, respectively, and in dart-thrower's flexion of 6° for both fluoroscopy and goniometry. No other ROMs after simulated SL arthrodesis were significantly different compared with baseline.

Conclusions The effects of simulated SL arthrodesis on radiocarpal and midcarpal motion compare favorably with motion after SL soft tissue repair and other reconstructive techniques that have been previously reported. The statistically significant decreases in wrist flexion and dart-thrower's extension-flexion after simulated SL arthrodesis are of questionable clinical importance.

Clinical relevance These results may support reconsidering SL arthrodesis as a viable treatment option for acute or chronic SL instability with regard to apparent minimal adverse effects on functional wrist ROM. *(J Hand Surg Am. 2016;41(9):e285–e293. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Scapholunate arthrodesis, scapholunate fusion, scapholunate instability, wrist arthritis, cadaveric study.

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Scapholunate (SL) interosseous ligament instability is the most common type of carpal instability.[1,2] The injury exists along a spectrum of severity depending on the force with which it occurred, typically beginning with disruption of the palmar segment of the SL ligament, then extending through the membranous component, and finally through the dorsal portion of the SL ligament. More serious injuries involve other intrinsic and extrinsic ligaments of the wrist and can lead to varying degrees of instability at the SL interval or throughout the wrist. Some patients with SL ligament injuries may experience only occasional wrist discomfort whereas others progress in a predictable pattern from early instability to scapholunate advanced collapse arthrosis.[3–6]

Although SL arthrodesis has been attempted, it is not currently employed widely as a treatment modality for SL instability. Authors of prior studies have reported high rates of nonunion and unpredictable outcomes.[7,8] However, if surgeons were able to obtain SL arthrodesis reliably, this might hypothetically achieve several goals for treating SL injuries in an effort to prevent SL advanced collapse wrist: (1) to keep the scaphoid from flexing pathologically and thus avoid point loading at the radioscaphoid joint; (2) to keep the SL interval from increasing, to maintain a good seat for the capitate proximal pole and prevent its proximal migration; and (3) to prevent the capitate and hand from translating dorsally relative to the forearm as the lunate tilts into extension from the SL injury. Hastings and Silver[9] reported acceptable results for 5 patients with intercarpal arthrodesis including 2 who were treated with SL arthrodesis for chronic instability. Zubairy and Jones[10] reported satisfactory results in 10 of 13 patients who underwent SL arthrodesis.

With newer fixation methods, it may be possible to achieve SL arthrodesis more reliably, such as has been accomplished for other limited intercarpal arthrodeses in recent years.[11] It is unclear to what degree SL arthrodesis would affect radiocarpal and midcarpal ROM, including the functionally important dart-thrower's range of motion (ROM).[12] We believe that the first step in proposing SL arthrodesis as a plausible treatment alternative for SL instability is to evaluate its effect on wrist motion. The purpose of this cadaver study was to evaluate the effect simulated SL arthrodesis has on wrist ROM. Even if SL arthrodesis could be achieved predictably *in vivo*, it may be a poor treatment option if it has a noticeable impact on functional wrist ROM.

MATERIALS AND METHODS

We prepared 10 cadaveric upper extremities in a similar fashion according to previously described protocols.[13,14] The mean age of the specimens was 78 years (range, 66–88 years). At the time of testing, specimens were thawed and disarticulated at the elbow joint. We performed manual and fluoroscopic examination of all limbs to ensure the absence of obvious pathology such as fractures or carpal instability as well as to confirm that there were no significant ROM abnormalities.

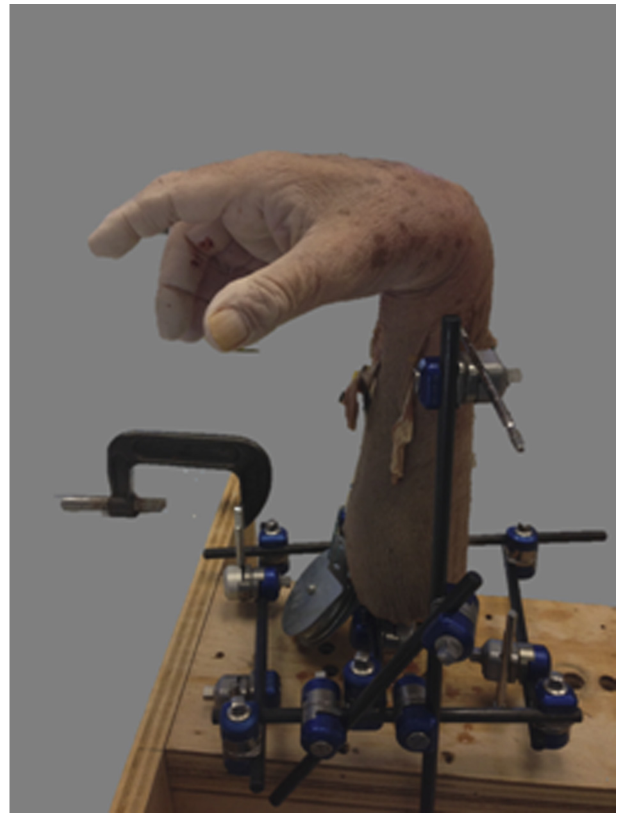

FIGURE 1: Example of weight suspension on tendons to simulate wrist motions.

We placed longitudinal 5-mm pins in the proximal ulna and radius intramedullary canals after cutting both bones in the proximal forearm. We placed an additional transverse 5-mm pin in the distal radius approximately 6 cm proximal to the radial styloid. These pins were used to mount the specimen during testing. We made central longitudinal volar and dorsal forearm incisions at the proximal end of the specimens to expose relevant wrist flexor and extensor tendons: flexor carpi radialis (FCR), flexor carpi ulnaris (FCU), extensor carpi ulnaris (ECU), and extensor carpi radialis longus/brevis (ECRL/ECRB). We secured sutures (number 3 Ethibond; Ethicon, Somerville, NJ) to the transected tendons. The forearm was then mounted onto a custom-made stand in a vertical orientation via the previously placed pins and an external fixator frame.