Association Between Lunate Morphology and Carpal Collapse Patterns in Scaphoid Nonunions

Steven C. Haase, MD, Richard A. Berger, MD, PhD, Alexander Y. Shin, MD

From the Department of Surgery, University of Michigan Health System, Ann Arbor, MI; and the Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN.

Purpose: Type I lunates have a single distal facet for articulation with the capitate; type II lunates have an additional (medial) hamate facet on the distal articular surface. We retrospectively reviewed a series of patients with scaphoid nonunions to determine if there was an association between lunate morphology and the degree of carpal instability observed. Association between lunate morphology and the location of the scaphoid fracture (proximal or waist) was also investigated.

Methods: Radiographs were evaluated for 45 patients with established scaphoid nonunions. Lunate morphology, scaphoid fracture location, and radiolunate angle were determined.

Results: Type I lunates were present in 21 patients. Of these, 15 were found to have a dorsal intercalated segment instability pattern (radiolunate angle greater than 15°). By contrast, only 4 of the patients with type II lunates exhibited this pattern of instability. No significant association was found between lunate morphology and the scaphoid fracture location.

Conclusions: Type II lunate morphology is associated with significantly decreased incidence of dorsal intercalated segment instability (DISI) deformity in cases of established scaphoid nonunion ($p = .0002$). Lunate morphology, however, was not significantly associated with the location of the scaphoid fracture in these cases ($p = .19$). (J Hand Surg 2007;32A: 1009–1012. Copyright © 2007 by the American Society for Surgery of the Hand.)

Type of study/level of evidence: Prognostic IV.

Key words: Carpal instability, DISI, lunate, morphology, scaphoid nonunion.

The lunate has often been described as the cornerstone or keystone of the wrist.[1,2] This title is well deserved, as this carpal bone is uniquely positioned at the middle of both the transverse and coronal arches of the carpus. Critical ligamentous attachments between the lunate, the scaphoid, and the triquetrum allow for stability within the proximal carpal row. Additionally, the lunate is the intercalated segment between the radius and distal carpal row.

Variations in lunate morphology have been described in several different ways. In 1966, Antuna Zapico divided lunates into three types (I, II, and III) based on whether the proximal surface was curved or angulated.[3] Watson's three lunate types (D, V, and N) are based on the lateral appearance on radiography.[4] In 1990, Viegas classified lunates by their distal articular morphology[5,6]: type I lunates with a single capitate facet and type II lunates with an additional hamate facet on the medial portion of the distal articular surface, as shown in Figure 1. In the same year, Burgess also described this finding, along with matching variations of hamate morphology, referring to these as type I and type II midcarpal joints.[7]

The presence of a medial (hamate) facet has been linked to increased incidence of proximal hamate arthrosis.[8–10] Compared with type I lunates, type II lunates have considerably different kinematics during radial-ulnar deviation of the wrist.[11]

Anecdotally, we have noticed a tendency for wrists with type II lunate morphology to exhibit less dorsal intercalated segment instability (DISI) deformity, in cases where this deformity is commonplace.

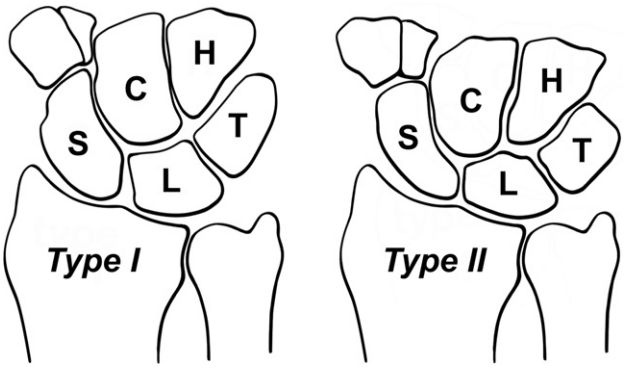

Figure 1. Type I lunates (L) have a single distal facet that articulates with the capitate (C). Type II lunates have an additional facet for articulation with the hamate (H). (T = triquetrum, S = scaphoid) [Copyright Mayo Foundation].

DISI deformity[12] describes the abnormally extended posture of the lunate bone relative to the longitudinal axis of the radius, as seen on lateral radiographs. This radiographic manifestation of carpal instability is often seen in cases of scapholunate dissociation or scaphoid nonunion. Both of these cases are forms of the carpal instability dissociative (CID) pattern, and both lead to abnormal extension of the lunate, as it is dissociated from the flexion moment of the distal scaphoid.

The purpose of this study was to evaluate the association, if any, between lunate morphology and the presence of DISI deformity. We also wanted to determine if there was any association between lunate morphology and the site of the scaphoid fracture (proximal pole or waist). We believe these associations, if present, may lead to new understandings regarding instabilities of the wrist.

Our null hypotheses were as follows: (1) Lunate morphology is NOT associated with the presence of DISI deformity. (2) Lunate morphology is NOT associated with the location (proximal or waist) of scaphoid fractures.

To test these hypotheses, we set out to perform a retrospective review of a group of patients predisposed to DISI deformity (patients with scaphoid nonunions).

Materials and Methods

Institutional review board approval was granted for this study. Surgical records for the years 1994 through 2003 were searched, and 52 consecutive patients who had undergone vascularized bone grafts for established scaphoid nonunion were identified. The records for these patients were reviewed, with specific regard to preoperative radiographic studies. Seven patients were excluded due to lack of adequate preoperative radiographs. The remaining 45 patients were included in this analysis.

Preoperative wrist x-ray films were reviewed for each patient, determining radiolunate angle, scaphoid fracture location, and lunate morphology (Fig. 2). The radiolunate angle was determined from lateral wrist radiographs using the tangential method.[13] The patient was determined to have DISI deformity if the radiolunate angle was greater than 15°.[14] Lunate morphology and scaphoid fracture location were determined by examination of standard posterioanterior wrist radiographs. If a medial lunate facet could be identified, the lunate was classified as type II.[5]

Statistical analysis was performed using the chi-square test to determine if there was a statistically significant relationship between the variables measured. Statistical significance was set at $p < .05$.

Results

The study group was composed of 37 males and 8 females. The average age was 23 (range 13–66). Type I lunates were identified in 21 (47%) cases.

Table 1 shows the distribution of lunate morphology and DISI deformity. Chi-square analysis shows that this relationship is statistically significant ($p = .0002$).

Nine patients with type I lunates sustained a proximal pole fracture. Of the patients with type II lunates, 15 had proximal pole fractures. On chi-square analysis, this distribution was not statistically significant.

Further analysis of the data was conducted to see if there was an association between fracture location and the development of DISI deformity. Of the proximal pole fracture patients, 5 developed DISI deformity, whereas 14 patients with scaphoid waist fractures developed DISI deformity. This was found to be a significant association ($p = .002$).

Discussion

Scaphoid nonunion is a condition well known to predispose to carpal instability, specifically DISI deformity. Upon close examination of a cohort of scaphoid nonunion patients, we found a significantly decreased incidence of DISI deformity among those

Table 1. Lunate Morphology and DISI Deformity

Lunate Morphology	DISI Present	DISI Absent
Type I	15	6
Type II	4	20