Injuries to the scapholunate region are among the most common acute and chronic wrist ligament injuries treated by orthopaedic surgeons. Diagnosis and treatment guidelines have changed as a result of the continued clinical experience with this condition. To diagnose this injury accurately requires a thorough understanding of the pertinent normal anatomy and kinematics, patterns of injury, and the relative utility of the various imaging methods. The advent of new treatment techniques, as well as current research into the reconstruction of this complex soft-tissue lesion, makes defining the optimal treatment for an individual patient a constantly developing process. Scapholunate dissociation may be either static or dynamic. In the latter instance, standard wrist radiographs are always abnormal. In the former, standard radiographs are normal, and the diagnosis is made with a combination of pertinent findings on clinical examination and stress radiographs or, in many cases, with diagnostic arthroscopy.

Anatomy

Stability of the scapholunate complex depends on both extrinsic capsular ligaments and the scapholunate intersosseous ligament (SLIL). The SLIL is a C-shaped structure connecting the dorsal, proximal, and volar surfaces of the scaphoid and lunate (Fig. 1). The cross-sectional anatomy of this ligament varies considerably from dorsal to volar. The dorsal portion of the ligament is thick (2 to 3 mm) with transversely oriented bundles of collagen. This portion appears to provide the bulk of the ligament’s resistance to diastasis between the proximal pole of the scaphoid and lunate. Between the most proximal portions of the scaphoid and lunate, the SLIL is thin and fibrocartilaginous and blends into the attachment of the ligament of Testut (palmar radioscapoholunate ligament). This proximal, fibrocartilaginous portion of the SLIL is most easily visualized during wrist arthroscopy. Palmar to the radioscapoholunate ligament attachment lies the palmar portion of the SLIL, which is thin (1 mm) and obliquely oriented (Fig. 1).

Other intersosseous ligaments that stabilize the scaphoid include the scaphocapitate and scaphotrapezium-trapezoid ligament (Fig. 2). Their attachments near the distal pole of the scaphoid provide additional re-
sistance to scaphoid flexion.

The palmar capsular ligaments, which provide support for the scaphoid and lunate, include the radioscaphocapitate ligament and long and short radiolunate ligaments (Fig. 2). The radioscaphocapitate ligament attachment to the palmar radial cortex of the scaphoid makes it analogous to a radial collateral ligament, while the long and short radiolunate ligaments stabilize the lunate in rotation. Dorsal capsular ligaments include the dorsal radiocarpal and dorsal intercarpal ligaments, which share insertions on the triquetrum (Fig. 3). The orientation of these fibers provides the basis for the preferred incision used with a dorsal capsulotomy, which splits the dorsal radiotriquetral ligament proximally and the dorsal intercarpal ligament distally (Fig. 4).

**Kinematics**

An understanding of the salient points of carpal kinematics is necessary to highlight differences between normal and injured wrists. Several theories to explain carpal kinematics have been proposed. These include, among others, the row, column, and oval ring theories. In the row theory, the proximal carpal row is interlinked by the interosseous ligaments and moves independently of the distal carpal row. In flexion-extension, the scaphoid and lunate rotate together but the scaphoid moves through a greater arc. The scaphoid also pronates and ulnarily deviates during wrist flexion, which partially explains the oblique asymmetry of the scapholunate interval that develops after injury to the SLIL. This scapholunate interval (or gap) also changes with radial-ulnar deviation of the wrist. The scaphoid flexes during radial deviation and extends with ulnar deviation, which maintains the continuity between the rows during motion in the frontal plane. However, with an SLIL injury, the scaphoid will remain flexed while the lunate extends, especially with radial-to-ulnar deviation, and the diastasis or gap between the scaphoid and lunate often will enlarge.

The column theory posits a lateral column (scaphoid, trapezoid, trapezium), a central column (capitate and lunate), and an ulnar column (hamate and triquetrum). It is proposed that each column pro-

![Figure 1](image1.png)  
**Figure 1** The scapholunate interosseous ligament (SLIL) viewed from the proximal/radial side with the scaphoid removed. (Adapted with permission from Cooney WP, Linscheid RL, Dobyns JH [eds]: The Wrist: Diagnosis and Operative Treatment, vol 1. St Louis, Mo: Mosby-Year Book, 1998. By permission of Mayo Foundation.)

![Figure 2](image2.png)  
**Figure 2** Palmar view demonstrating interosseous wrist ligaments and palmar radiocarpal ligaments (in bold type). The key ligaments are the radioscaphocapitate, long and short radiolunate, and ulnar carpal ligaments (ulnolunate, ulnotriquetral and ulnocapitate ligaments). C = capitate; H = hamate; I = first metacarpal; L = lunate; P = pisiform; R = radius; S = scaphoid; Td = trapezoid; Tm = trapezium; U = ulna; V = fifth metacarpal. (By permission of Mayo Foundation.)
vides different types of wrist stability. The lateral column is mobile; the central column provides flexion-extension and the medial column, carpal rotation. Craigen and Stanley have demonstrated that individual carpal bone motion varies with wrist motion and that women are more likely to have a wrist that demonstrates column-type kinematics.

In the oval ring theory, articular contact and ligament control are provided by the radial and ulnar connections in the carpus between the proximal and distal carpal rows. Mobility and carpal stability are controlled by linkages between the scaphoid and trapezium radially and the lunate and triquetrum ulnarily. Instability results when a break occurs in a linkage. Both the row theory and oval ring theory appear to be more in agreement with commonly recognized concepts of carpal instability and scapholunate dissociation.

The effect of sequential sectioning and repair of the SLIL on wrist kinematics has been evaluated in the laboratory. The dorsal region of the ligament was found to be the most important structure defining the alignment and kinematics of the scapholunate complex. The palmar region appears to have a limited effect on scapholunate kinematics. With an SLIL tear, the scaphoid will flex and rotate away from the lunate. The scaphoid moves in continuity with the distal carpal row through its attachments to the trapezium, trapezoid, and capitate, while the lunate and triquetrum move together as a proximal carpal row unit. With the scaphoid and lunate no longer linked, the lunate and triquetrum extend. This combination of scaphoid flexion and lunate extension produces a dorsal intercalated segment instability (DISI deformity), which is characteristic of scapholunate disassociation. Carpal kinematics are altered as a result.

Individual differences in carpal kinematics and carpal ligament laxity may be factors in explaining the varied clinical presentations and treatment results of carpal instability.

Material Properties

Cadaveric studies have been used to evaluate the stabilizing function of the SLIL as well as the material properties of the three separate ligament regions. The dorsal region of the ligament provides the greatest constraint to translation between the scaphoid and lunate in the dorsal-palmar direction, while both the dorsal and palmar regions constrain the extremes of rotation between the scaphoid and lunate. The dorsal region is the strongest, failing at approximately 250 N of stress, followed by the palmar region (120 N) and the proximal region (60 N). The breaking strengths (i.e., strengths to failure) of the radiocarpal ligaments also have been determined (100 N for the radial collateral ligament, 150 N for the radioscaphocapitate, 110 N for the long radiolunate, and 40 N for the radioscapholunate ligament [ligament of Testut]). It appears that injury must occur to both interosseous and capsular ligaments for rotational instability of the scaphoid to be present. This is therefore the rationale for incorporating a capsulodesis or tenodesis procedure into the SLIL repair to restore stability.

Mechanism of Injury

The exact mechanisms of injury that produce scapholunate dissociation
have not been fully elucidated. Mayfield et al and Johnson suggest that a sudden impact load applied to the base of the hypothenar region of the hand with the wrist in extension, ulnar deviation, and supination produces a scapholunate dissociation. In theory, with the wrist in this position, the capitate is driven between the scaphoid and lunate, the scaphoid is forced away from the lunate radially and dorsally, and the lunate is displaced ulnarly and palmarly.

The degree of initial injury required to produce scapholunate diastasis and pathologic lunate rotation is still poorly understood. Berger et al demonstrated few kinematic changes after SLIL sectioning, whereas Short et al showed scaphoid flexion and pronation as well as lunate extension after SLIL section, with the degree of diastasis between the scaphoid and lunate dependent on the direction of wrist motion. Capsular ligament support is undoubtedly an important factor influencing the findings. The occurrence of the initial injury or an injury followed by repetitive stress may cause a slow attenuation of capsular ligaments, allowing further instability. Wolfe et al reported a case of hyperextension wrist injury with normal scapholunate angle and interval on initial radiographs and slow progression to frank carpal instability over the next 11 weeks. The association of interosseous ligament injuries with distal radius fractures also has been described.

### Diagnosis

**History and Physical Examination**

A history of a fall or sudden load on the wrist should alert the clinician to consider in particular a radial-sided wrist injury, such as scaphoid fracture or scapholunate instability. Some diagnoses, such as scaphoradial arthritis, radioscaphoid arthritis, de Quervain’s tenosynovitis, dorsal wrist impaction syndrome, dorsal ganglion cyst, and perilunate wrist instability, can be excluded after a careful clinical history and examination of the wrist. Some patients with wrist injuries may not be able to recall one specific episode of trauma, as is frequently the case with scaphoid fractures that initially present with nonunion. This may be the result of the relatively trivial nature of the original injury, which is ignored by the patient because of the demands of athletic competition or work. Wrist instability also may be associated with synovitis, which can contribute to gradual ligament attrition. Repetitive stress alone, however, is relatively unlikely to produce a scapholunate dissociation.

The history reported by the patient with scapholunate dissociation usually includes weakness and pain with loading activities (such as push-ups). Physical findings usually include swelling in the radial snuffbox or dorsoradial tenderness over the scapholunate interval just distal to Lister’s tubercle, discomfort at the extremes of wrist extension and especially radial deviation, and a positive ballottement test (dorsal-volar stress manipulation of the scapholunate interval). Subluxation of the proximal pole of the scaphoid associated with a clunk during dynamic wrist loading (the Watson maneuver) frequently is present on dynamic testing. The Watson test is particularly important in the diagnosis of dynamic scapholunate instabilities. It is performed by placing the wrist in ulnar deviation and supporting the distal end of the scaphoid with the examiner’s thumb palmarly at the scaphoid tubercle. The wrist is then radially deviated. A sensation or palpation of a catch or clunk is felt as the scaphoid subluxates over the dorsal rim of the distal radius. There also may be progressive loss of grip strength when the patient is asked to do a repetitive gripping maneuver.

### Imaging

Because many methods of radiographic imaging are available, an organized approach is best for determining the sequence of different imaging techniques as well as the role of arthroscopy in evaluating the painful, unstable wrist. The initial study is complete radiographic assessment with six views of the wrist (posteroanterior, lateral, radial deviation, ulnar deviation, flexion, and extension). In a patient with scapholunate dissociation, standard posteroanterior radiographs (neutral radioulnar deviation) show an increased scapholunate gap (≥3 mm compared with the opposite wrist), a cortical ring sign of the flexed scaphoid (the ring appearing <7 mm from the proximal pole), and extension of the lunate with prominence of the volar pole, which overlaps the proximal capitate, characteristic of dorsal rotation of the trapezoid-shaped lunate. The scaphoid is vertical due to the rotary subluxation (Fig. 5, top). Lateral radiographs best show scaphoid flexion and lunate extension relative to the radius (Fig. 5, bottom). The longitudinal axes of the scaphoid and lunate are used to determine the scapholunate angle, which is 95 degrees (normal, 45 ± 15 degrees). The lunocapitate angle measures 30 degrees (normal, 0 ± 10 degrees). The scapholunate angle also can be measured by assessing the degree of palmar scaphoid flexion with respect to the volar cortical surface of the distal radius. An associated dorsal translation of the capitate on the lunate also can be measured. Flexion and extension lateral views will show motion occurring primarily at the lunocapitate joint and an uncoupling of the normally synchronous scapholunate motion. Radial...
Scapholunate Interosseous Ligament Injuries

Dioulnar deviation may show a closing scapholunate gap, with radial deviation and opening of the gap with ulnar deviation. The clenched-fist posteroanterior views may accentuate these changes, especially the scapholunate diastasis.

Among other findings that may be present in long-term scapholunate dissociation are isolated scaphotrapeziotrapezoid arthritis, calcification of articular cartilage from calcium pyrophosphate deposition, and advancing stages of arthrosis, which typically follow a pattern termed scapholunate advanced collapse.

In patients with subacute and dynamic scapholunate dissociation, the standard radiographic views of the wrist usually do not demonstrate any abnormalities. To make a diagnosis of both subacute (usually <3 months from injury) and dynamic scapholunate instability, additional imaging information is usually required. The next imaging modality should be midcarpal and radiocarpal arthrography. Wrist arthrography may demonstrate an SLIL tear, although arthrography cannot help in assessing the size of the tear. In addition, asymptomatic perforations have been found in the contralateral wrist, so interpretation must be correlated with clinical findings. Conversely, comparative studies have shown only a 60% sensitivity of arthrography compared with arthroscopy. Nonetheless, arthrography remains a valuable screening tool to demonstrate SLIL tears, determine the potential diagnosis in combination with other studies, and serve as a prelude to arthroscopy or arthrotomy of the wrist.

Arthroscopy currently is considered to be the imaging method of choice by most surgeons. Radiocarpal and midcarpal arthroscopy with triangulation probing greatly assist in the diagnosis and staging of scapholunate dissociation (Fig. 7). Staging the severity of an SLIL tear can be performed best by radiocarpal and midcarpal arthroscopy.

Arthroscopy

Figure 5  Posteroanterior (top) and lateral (bottom) radiographs show increased scapholunate gap (arrowhead), volar flexion of the scaphoid (ring sign), and lunate dorsiflexion. (By permission of Mayo Foundation.)

Figure 6  A, Coronal T2-weighted fast spin echo MRI (2,137/100) of flap tear of the SLIL. The wrist is in neutral position. The arrow indicates the free edge of the torn ligament on the scaphoid. (Reproduced with permission.)  B, Coronal T2-weighted MRI of SLIL tear (arrow) and separation of the scaphoid and lunate. (Reproduced with permission.)
Geissler et al \(^{33}\) have proposed a method of quantifying the degree of interosseous ligament injury by probe placement into the scapholunate interval from the radiocarpal and midcarpal joint on wrist arthroscopy. In grade I injuries, attenuation of the interosseous ligament is seen from the radiocarpal space with no midcarpal step-off. Patients with suspected injuries are often immobilized. In grade II injuries, attenuation is seen from the radiocarpal joint (Fig. 7, A and B), and an incongruency between the scaphoid and lunate is seen from the midcarpal joint (Fig. 7, C). With Kirschner wire (K-wire) joysticks placed percutaneously dorsally into the scaphoid and lunate, the midcarpal step-off is reduced and the scapholunate interval is pinned for 6 to 8 weeks. In grade III and IV injuries, a complete separation between the scaphoid and lunate is seen from both the radiocarpal and midcarpal spaces. In the grade III injury, a small 1-mm probe passes between the carpal bones, and in the grade IV injury, a 2.7-mm arthroscope passes between the carpal bones. Grade III represents an increased separation between the scaphoid and lunate with normal scapholunate angles, whereas grade IV represents an established scapholunate dissociation with a scapholunate gap ≥3 mm on the anteroposterior view and a lateral scapholunate angle ≥70 degrees. The grade III carpal instability should be treated by open repair. The grade IV should be treated by open repair combined with a capsulodesis.

Arthroscopy of the wrist is now recognized as an essential component of evaluation of scapholunate instability. Both the radiocarpal and the midcarpal space must be evaluated arthroscopically when scapholunate instability is suspected. Wrist arthroscopy is not complete if the midcarpal space is not examined in the assessment of scapholunate instability.\(^{33,34}\)

### Treatment

#### Determination of Surgical Treatment

Surgical treatment of scapholunate injuries is determined based on time elapsed from injury, the amount of carpal instability, and the presence of any secondary changes in the carpus (Table 1).

Treatment decisions can be separated into three categories based on the chronicity of the instability: acute, subacute, or chronic. For patients with acute scapholunate instability, who may initially present with symptoms compatible with a wrist sprain, splint or cast immobilization was often recommended. With the diagnostic tests of wrist arthrography and wrist arthroscopy, earlier diagnosis of actual ligament tears should lead to more specific treatment initially, such as percutaneous pin fixation or open SLIL repair. The degree of tear of the SLIL as assessed by wrist arthroscopy assists in determining the treatment. Partial tears of the SLIL discovered by arthroscopy (grades I and II) potentially can progress, and the recommended treatment by some authors is arthroscopic pin fixation for 6 to 8

<table>
<thead>
<tr>
<th>Type</th>
<th>Radiographic Presentation</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>Subacute</td>
<td>Dynamic deformity(^{*})</td>
<td>Conservative (splinting), arthroscopic pinning, capsulodesis</td>
</tr>
<tr>
<td>Acute</td>
<td>Static deformity</td>
<td>Open repair of SLIL</td>
</tr>
<tr>
<td>Late (Chronic)</td>
<td>Static deformity</td>
<td>Open repair of SLIL and capsulodesis alone, tenodesis alone, intercarpal fusion (STT or SC(^{+}))</td>
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\(^{*}\) Dynamic deformity = present on stress (motion radiographs); positive clinical stress testing, positive arthroscopy, but negative arthrogram and normal static radiographs

\(^{+}\) STT = scaphotrapezial-trapezoid; SC = scaphocapitate
weeks to promote ligament healing or to affect a scapholunate joint chondrodesis.\textsuperscript{35,36}

Whipple\textsuperscript{22} described arthroscopic reduction and pinning of the scapholunate interval with multiple (4 to 5) pins. He reported an 85% incidence of symptom relief with 2- to 7-year follow-up in patients whose initial presentation was <3 months from injury and who had a <3-mm side-to-side gap difference. Other authors refer to this same pathologic entity as dynamic scapholunate dissociation and recommend capsulodesis to support the weakened SLIL.\textsuperscript{37}

Acute, complete tears of the SLIL, which can occur with perilunate dislocations of the wrist and commonly are associated with the finding on plain radiographs of scapholunate diastasis, are best treated by open reduction and repair of the SLIL. Neutralization of rotational forces during healing usually is augmented by pin stabilization.\textsuperscript{38-40}

Subacute scapholunate dissociation presents weeks or months after the initial ligament tear and often with limited clinical findings. The Watson stress test is positive but static imaging studies can be negative. Dynamic wrist imaging will usually show a scapholunate diastasis. Arthrography often is negative, but wrist arthroscopy is positive, particularly at the midcarpal arthroscopy. This condition also is referred to as dynamic scapholunate dissociation. Treatment of subacute or dynamic scapholunate dissociation is by capsulodesis or tenodesis when conservative treatment fails.

SLIL tears recognized late (>12 weeks from initial injury) present as established or chronic carpal instability. They have the classic radiographic findings of scapholunate dissociation with a scapholunate diastasis and increased scapholunate angle.\textsuperscript{38,39} Wrist arthrography and arthroscopy usually are not needed to determine the diagnosis. If sufficient ligament remains for repair and the dissociation is correctable at the time of surgery, then direct ligament repair combined with dorsal capsulodesis, as described by Lavenna et al\textsuperscript{29} Dobyns and Linscheid\textsuperscript{38} and Cooney et al\textsuperscript{40} is recommended. Otherwise, stabilization procedures such as capsulodesis\textsuperscript{41,42} tenodesis\textsuperscript{43,44} or intercarpal fusions are recommended.

**Repair Techniques**

**Scapholunate Ligament Repair**

A number of techniques exist for the treatment of scapholunate dissociation. Primary repair of the SLIL is recommended for acute injury, for subacute injury with established ligament dissociation (positive arthrogram and Geissler stage III or IV arthroscopic instability), and, combined with capsulodesis or tenodesis, for chronic instability.

In the direct repair technique (Fig. 8), the scapholunate interval is assessed from a dorsal approach. The dorsal capsular incision is planned to construct a capsulodesis to assist the repair. The SLIL is almost always attached to the lunate. The proximal pole of the scaphoid is prepared by freshening the proximal edge with a curette or burr and by placing drill holes for sutures that will be placed through the ligament. Horizontal mattress sutures of 2-0 or 3-0 Ticron (Davis & Geck, Wayne, NJ) are placed in the SLIL and passed through drill holes that exit at the waist of the scaphoid (Fig. 8, C and D). K-wires (0.0625 inch) are placed dorsally.

![Figure 8](image-url)
to act as joysticks to reduce the scapholunate interval. Once reduced, the scapholunate interval is pinned by a minimum of two 0.035- or 0.045-inch K-wires. The dorsal joystick K-wires are removed and the sutures securely tightened.

Capsulodesis

Capsulodesis is strongly recommended for late (chronic) instability to augment the ligament repair. Capsulodesis alone also is recommended for subacute (dynamic) scapholunate instability. The Blatt repair41 utilizes a distally based dorsal flap of capsule that is left attached to the radial styloid (Fig. 9). A notch for flap attachment is made in the distal scaphoid. This capsular flap is attached distally to the scaphoid, either through a drill hole (dorsal to palmar with a tie-over button) or with a suture anchor. The capsular flap (ligament) is inserted after the scaphoid is derotated and held with a K-wire. The second option is the dorsal intercarpal ligament capsulodesis1,42 (Fig. 10). The dorsal intercarpal ligament is elevated at the time of wrist exposure so that it is lifted off the triquetrum ulnarly but left attached to the distal carpal row and specifically to the distal scaphoid radially. This ligament strip (with its distal carpal attachments) then is sutured to the dorsal radius. The scaphoid is rotated out of flexion to neutral position (45-degree scapholunate angle) and held with the capsulodesis. Both the Blatt capsulodesis and dorsal intercarpal capsulodesis work by holding the scaphoid extended and supporting the SLIL repair.

Tenodesis of the Wrist

Tenodesis of the wrist is an alternative surgical approach to the problem of the unstable scaphoid. For tenodesis, a tendon is harvested through either a dorsal or palmar surgical approach, freed throughout its length, then transferred through the distal scaphoid and attached to the dorsal radius (or lunate) to serve as a method of stabilizing the unstable scaphoid. Popular techniques described include that of Linscheid1, Brunelli and Brunelli43 and Van Den Abbeele et al44 in the technique of Linscheid, half of the extensor carpi radialis tendon is released proximally and left attached distally to the base of the second metacarpal. The detached end is passed dorsally to palmarly through a drill hole in the scaphoid tuberosity (Fig. 11, A). The tendon exiting from the palmar hole is pulled through the drill hole to connect to a small incision over the scaphoid tuberosity (Fig. 11, B). The tendon end is then passed around the waist of the scaphoid (volar back to dorsal), then ulnarly to the lunotriquetral ligament and dorsal joint capsule (Fig. 11, C). Part of the tendon can be used to reinforce the dorsal aspect of the scaphoid.

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**Figure 9** Blatt dorsal capsulodesis. A, Distally based capsular flap is attached to the scaphoid to create derotation (arrows). B, Tightening of the capsulodesis applies pressure to the distal scaphoid (arrows). (Adapted with permission from Blatt G: Dorsal capsulodesis for rotary subluxation of the scaphoid, in Gelberman RH (ed): The Wrist, New York, NY: Raven Press, 1994, pp 147-167.)

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**Figure 10** Schematic of intercarpal ligament capsulodesis using the proximal half of the dorsal intercarpal ligament (DIC) to link the distal scaphoid to the distal radius. A, The scaphoid is rotated into extension by the capsulodesis of the proximal half of the DIC (arrow), which is attached to the dorsal rim of the distal radius. DRC = dorsal radiocarpal ligament. B, Lateral view of the DIC capsulodesis showing derotation (arrow) of the scaphoid. (By permission of Mayo Foundation.)
SLIL repair before its final attachment distally on the capitate to a suture or through drill holes (Fig. 11, D).

In the procedure of Brunelli (Fig. 12), half of the flexor carpi radialis tendon is harvested from a palmar approach. The distal end is left attached to the trapezoid and base of the second metacarpal. The freed proximal end is passed volarly to dorsally through a drill hole in the scaphoid. The scaphoid is realigned and the tendon pulled taut. The tendon end is then inserted dorsally into the distal radius. This tenodesis serves to tighten the palmar scaphotrapezial-trapezoid ligaments distally and to derotate the scaphoid proximally, correcting carpal alignment.

An alternative insertion of the tendon dorsally onto the lunate rather than to the distal radius was described by Van Den Abbeele et al (Fig. 12, B). Both tenodesis procedures can be used alone, as can the dorsal capsulodesis procedures, when the SLIL cannot be directly repaired.

**Bone-Ligament-Bone Techniques**

Attempts to achieve a reconstruction that more closely reproduces the dorsal support of the SLIL have generated research into using bone-ligament-bone composite grafts. Tarsometatarsal joint autograft, SLIL allograft, and bone-retinaculum-bone autograft harvested from the dorsal radius have all been attempted (Fig. 13).

These procedures currently are investigational, and there have been no long-term assessments of the outcome of bone-ligament-bone reconstructive procedures for scapholunate dissociation. The capitohamate ligament composite serves as an excellent source for graft to replace the SLIL. With a dorsal approach, the dorsal capitohamate ligament is harvested as a bone-ligament-bone graft and transferred to the scapholunate interval.

### Intercarpal Fusion

Shortcomings in soft-tissue techniques have caused some to advocate scaphoid stabilization by scaphotrapezial-trapezoidal (STT) fusion or scaphocapitate (SC) fusion. Although it provides stabilization of the scaphoid and restores scaphoid alignment with the distal radius, intercarpal fusion can change carpal kinematics substantially, potentially leading to later degenerative arthritis.

Advocates recommend intercarpal fusion when there is immediate need for a stable wrist, reasonable motion, and heavy manual

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**Figure 11** Ligament augmentation of Linscheid. 
A, Strip of detached extensor carpi radialis longus tendon, with K-wire joysticks inserted into the scaphoid and lunate. B, The tendon is pulled through the drill hole. C, The tendon is then passed across the dorsal part of the scapholunate interval to the triquetrum and through the ulnar wrist capsule. D, The tendon can be used to reinforce the dorsal portion of the SLIL. (By permission of Mayo Foundation.)

**Figure 12** Brunelli technique of tenodesis. 
A, Half of the flexor carpi radialis (FCR) tendon is passed through the distal pole of the scaphoid. B, Dorsal view showing the FCR sling attached to either the distal radius (the original Brunelli technique) or to the dorsal lunate (the modified technique of Van Den Abbeele et al). (Adapted with permission.)
labor. Watson et al.49 have demonstrated satisfactory fusion rates, with retention of 70% of normal motion and 80% of grip strength. Early outcome appears to be satisfactory. Radial styloidectomy has been recommended to improve motion and to reduce the incidence of arthritis secondary to radial-scaphoid impingement.51 The combination of an STT or SC fusion, which realigns the proximal scaphoid to the scaphoid fossa of the distal radius, and a limited radial styloid excision, which makes the radioscaphoid joint more congruent, seems to offer satisfactory long-term results in properly selected patients.52

Salvage procedures for late scapholunate dissociation are based on the pathophysiology and progression of degenerative arthritis. In general, a proximal row carpectomy (provided no lunocapitate arthritis exists) or scaphoid excision and midcarpal fusion provide reasonable options of treatment.52-54 These procedures can preserve an arc of motion that is about 50% of normal while relieving pain secondary to degenerative changes.

**Summary**

The future treatment of SLIL dissociation likely will center around improved diagnostic assessment of the combined capsular and interosseous ligament injuries. Diagnosis and treatment algorithms likely will incorporate minimally invasive radiographic assessment, wrist arthroscopy, and surgical procedures that focus on each component and reduce the postoperative period of wrist immobilization, resulting in improved wrist motion, strength, and stability.

**References**


