

DIAGNOSIS AND SURGICAL TREATMENT OF ACUTE SCAPHOLUNATE LIGAMENT INJURIES

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Abstract

Scapholunate ligament (SLL) injury is difficult to recognize and a frequently missed diagnosis, leading to a decline in wrist mobility and functionality. Scapholunate injuries are the most frequent cause of carpal instability and often account for progression to abnormal joint mechanics, cartilage wear, and degenerative changes. Acute intervention is shown to improve outcomes, which is why accurate diagnosis of this condition is essential for successful treatment. In this review article, we present the mechanism of injury, degree of incidence, methods for accurately assessing this injury, and different treatment options used to manage an SLL injury.

A scapholunate ligament (SLL) injury is a tear of the interosseous ligament connecting the scaphoid and lunate bones. This is commonly caused by a fall onto an outstretched hand with the wrist in extension, ulnar deviation, and midcarpal supination¹. The SLL normally stabilizes the proximal carpal row for proper wrist kinematics. Injured patients may present with a decreased grip strength and a limited range of motion. SLL injuries are classified as acute if identified within 6 weeks of injury and chronic thereafter².

Traumatic tears of the SLL are the most commonly recognized ligament injuries of the carpus³ (Figs. 1-A and 1-B). The true prevalence of this injury is currently unknown and likely underestimated. In a clinical study analyzing cases with an initial diagnosis of wrist sprain, 19% had an increase in the scapholunate interval and 5% had severe instability of the scapholunate joint, indicating ligament injury and dysfunction⁴. Cadaveric studies have found that 35% had some degree of SLL tear⁵. In an examination of 42 confirmed SLL ruptures through arthroscopy, 43% were missed when only plain radiographic imaging on the wrist was used⁶.

Diagnosis

Acute SLL injuries are frequently missed because necessary radiographic views are often omitted. Traditional anteroposterior radiographic imaging can be insufficient in capturing an appropriate angle to allow accurate diagnosis of a SLL injury (Fig. 2-A). Static radiographic imaging of the scapholunate interval is complicated by the lack of a view that combines the dynamism of the posteroanterior (PA) clenched pencil view with the ability to reliably replicate the angle of pronation that shows the scapholunate interval^{7,8}. Furthermore, dynamic scapholunate dissociation only causes a distortion of the scaphoid and lunate bones during motion, which explains why it is frequently missed on conventional radiographs⁹.

A high index of suspicion is critical in a patient who presents with wrist pain after a fall on an outstretched hand, especially in the context of distal radius fractures where SLL injuries have been reported to occur in as high as 54% of cases⁴. Patients with subacute SLL injuries often present with a history of painful clicking activity, decreased grip strength, and localized tenderness about the scaphoid and dorsal SLL interval¹⁰. In many cases, a scaphoid shift test is used to assess the stability of the scapholunate



Fig. 1-A



Fig. 1-B

Figs. 1-A and 1-B Radiographs demonstrating an acute scapholunate ligament injury. **Fig. 1-A** An anteroposterior radiograph demonstrating a widened scapholunate (SL) interval (red). **Fig. 1-B** A lateral radiograph demonstrating dorsal intercalated segment instability. The abnormal dorsal angulation of the lunate is represented by the black arrow, perpendicular to the white line that demonstrates the plane of the lunate distal articular surface.

interval, but this test has a low sensitivity and further imaging techniques are often required for a more definitive diagnosis¹¹. The Moneim view (Fig. 2-B), or a 20° tangential PA view, is an effective way to examine the SLL without requiring a painful contraction or positioning by the patient¹².

The bilateral clenched pencil view should be used in addition to the Moneim view because it consistently

shows the widest scapholunate (SL) gaps⁸. Contralateral wrist comparison radiographs are strongly recommended because the difference in SL gap will be most recognizable, and in some patients, the SL widening may be physiologic rather than pathologic¹³. Radiographs are considered positive when at least one of the 3 criteria is met: a widened scapholunate gap of 3 mm or more, an increased scapho-



Fig. 2-A



Fig. 2-B

Figs. 2-A and 2-B Radiographs showing an acute scapholunate ligament injury. **Fig. 2-A** Anteroposterior view: note the difficulty in appreciating the interval between the scaphoid and the lunate using this view. **Fig. 2-B** Moneim view: this angle shows a clear view of the increased SL interval.

lunate angle of 60° or more, or an increased radiolunate angle of 12° or more. The cortical ring sign, which is an indication of increased scaphoid flexion, is also an indicator of SLL injury seen in plain radiography⁹.

Missed and untreated SLL injuries can result in painful and disabling posttraumatic wrist osteoarthritis. Injuries to the scapholunate joint account for a considerable degree of wrist dysfunction, lost time from work, and interference with activity. Untreated injuries to the SLL can lead to progressive degenerative changes known as scapholunate advanced collapse (SLAC), eventually causing arthritis of the entire carpus¹⁰ (Fig. 3).

Treatment

Acute surgical intervention before progression to a chronic state results in improved outcomes. Patients undergoing surgery with acute SLL injuries had a 96% success rate compared with those in the chronic timeframe with an 82% success rate, with superior QuickDASH scores associated with those treated in the acute phase² (Fig. 4). It is crucial that these interventions are performed as early as possible. In an analysis of isolated SLL injuries undergoing surgery in the chronic setting, 21% failed before the end of the study period, compared with none of the isolated injuries undergoing surgery in the acute setting².

Once identified, patients presenting with acute SLL injuries are referred to an orthopaedic or plastic surgeon for evaluation. A series of questions has been developed by Garcia-Elias et al.¹⁴ to provide a useful framework for determining the stage and treatment for any particular SLL injury. The questions are as follows:

1. Is the dorsal SL ligament intact?
2. Does the dorsal SL ligament have sufficient tissue to be repaired?
3. Is the scaphoid posture normal?
4. Is any carpal malalignment reducible?
5. Is the cartilage on the radiocarpal and midcarpal surfaces normal?



Fig. 3-A



Fig. 3-B

Figs. 3-A and 3-B Anteroposterior and lateral radiographs demonstrating a classic presentation of scapholunate advanced collapse wrist after SL injury.

These questions can be answered using the diagnostic imaging techniques listed above. Based on the responses to these questions, SLL injuries can be categorized with the corresponding treatments depending on the chronicity and severity of each injury. The spectrum of SLL injuries with respective treatments is detailed below.

A partial SLL injury is categorized by occult instability and is almost always initiated by a fall on an outstretched hand, presenting as pain with mechanical loading. This injury will have no abnormalities on either static or stress radiographs, although



Fig. 4

Postoperative anteroposterior radiograph showing the results of a reduction and association of the scaphoid and lunate procedure. Injury radiograph is shown in Figure 1-A.

dynamic fluoroscopic examination of the joint may be abnormal. These patients often benefit from conservative treatment such as casting, splinting, antiinflammatories, and physical therapy¹⁰. Arthroscopic debridement is indicated when nonoperative treatment has been unsuccessful and can be supplemented with other techniques such as k-wire fixation¹³.

Patients with dynamic instability resulting from a SLL tear will present with instability on stress examination and imaging. Stress radiographs are particularly useful in this stage of injury because static imaging often seems normal. Dynamic instability usually results from a high-energy impact and should be treated with direct repair of the ligament along with a dorsal capsulodesis to restore stability. Similarly, patients with a SL dissociation and a strong remaining ligament are best treated with open reduction of the displaced carpals, SL repair, and a dorsal capsulodesis¹⁰.

An injury that is characterized by a complete rupture of the SLL with an unreparable dorsal component, but with no carpal malalignment and few degenerative changes will often present as a noticeable gap of 3 mm or more within the SLL on static imaging.

This stage of injury can still be treated with ligament reconstructive procedures such as free tendon graft, tenodesis, and reduction and association of the scaphoid and lunate ligament^{10,13}. Although reconstruction options offer favorable outcomes for limiting the deteriorating pattern of carpal instability, they remain limited in their ability to restore full mobility¹³.

Massive ligament disruption often presents in a chronic setting and may lead to abnormal extension of the lunate and carpal collapse after SL dissociation. This injury is characterized by a prearthritic dorsal intercalated segment instability, and treatment is focused on reducing pain and restoring function while attempting to prevent progression to a SLAC wrist. Depending on the chronicity of the injury, a mobility-reducing salvage procedure may be indicated. Triligament tenodesis can be performed if the scaphoid and lunate are reducible and there are no degenerative changes at the radiocarpal joint. Other options for palliative treatment include arthroscopic debridement, anterior and posterior interosseous nerve neurectomy, and radial styloidectomy¹⁰.

Patients presenting with a SLAC wrist are treated with the goal of relieving pain with minimal functional loss. For early stage SLAC wrist, radial styloidectomy or radioscapulunate arthrodesis with distal scaphoid excision is recommended to preserve activities of daily living such as using a hammer¹⁰. In a patient who shows an intact midcarpal joint, proximal row carpectomy may be another option. If extensive degeneration is noted at the midcarpal joint, four-corner arthrodesis can be performed^{10,14}.

Conclusions

Although SLL injury is quite common, it is regularly missed on initial screening and can progress to a SLAC wrist after long-term deterioration. It is recommended to diagnose an SLL injury early because acute intervention leads to superior outcomes compared with the surgical or nonsurgical

management of chronic scapholunate injuries. The bilateral clenched pencil view should be used in addition to the Moneim view and contralateral wrist comparison radiographs to accurately diagnose a SLL injury. Treatment for SLL injuries should be based on the stage of injury and the degree of secondary ligamentous damage in addition to arthritic change.

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