

Scapholunate Advanced Collapse (SLAC Wrist)

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Introduction

Scapholunate advanced collapse (SLAC) describes a characteristic degenerative clinical wrist condition of progressive instability, deformity, and arthritis affecting the radiocarpal and midcarpal joints of the wrist. Specifically, the characteristic pattern of arthritic deformity and progressive instability occurs secondary to a long-term, chronic dissociation between the lunate and the scaphoid carpal bones. SLAC wrist is often the terminal and end-stage result from an untreated scapholunate interosseous ligament (SLIL) injury.^{[1][2][3]}

Etiology

Chronic SLIL injuries often result secondary to trauma although they can also occur in association with other degenerative or inflammatory arthritic conditions of the wrist. Many clinical presentations are either initially under-appreciated or may be acutely diagnosed as a "wrist sprain," and a formal/specialized orthopedic hand and upper extremity surgeon or a plastic hand specialist. Football linemen are particularly prone to "acute on chronic" repetitive SLIL injuries as these contact athletes are subject to high impact, forced wrist dorsiflexion moments for several years.^[4]

Epidemiology

SLAC is the most common degenerative condition of the wrist.^[5] The incidence of acute injury to the scapholunate ligament occurs in approximately 10% to 30% of intra-articular distal radius fractures. Degenerative tears occur in more than 50% of people over the age of 80 years old.^[6]

Pathophysiology

There is a well-established and recognized pathologic sequential algorithm for SLIL and SLAC wrist. The SLIL is a key stabilizer of the wrist and is a critical intercalating stabilizer to ensure normal, physiologic motion of the carpal bones, specifically the scaphoid and lunate bones.

As the normal opposing forces at the SL interval are lost, the scaphoid assumes an abnormally flexed position, while the lunate pathologically deviates into extension. This condition results in a dorsal intercalated segment instability (DISI deformity) pattern. The scapholunate angle increases to greater than 70 degrees while the lunate is extended to greater than 10 degrees beyond neutral. These abnormal flexion and extension positions alter the distribution of forces across the midcarpal and radiocarpal joints. Eventually, cartilage degeneration occurs beginning with the radioscapoid joint (recognized on radiographs at the radial styloid).

The pathologic cascade continues in an ulnar-based direction, with the final iteration yielding the collapse of the capitate proximally between a widened SL interval (known as the "Terry Thomas sign"), and end-stage

patterns include capitulunate arthritis. Of note, the radiolunate joint remains spared in the SLAC pattern of degenerative deformity.[7]

History and Physical

When a patient presents after a fall on an outstretched hand, the clinician should consider the possibility of a SLIL injury. These injuries can be seen in isolation, in the absence of fractures, but they can be present in association with distal radius and/or scaphoid fractures. Up to 30% of distal radius fractures have some degree of injury to the SL region. Aside from wrist trauma, SLIL secondary injuries may occur from other falls on the ipsilateral extremity (e.g., a fall on the elbow, for example), SLIL compromise secondary to underlying inflammatory arthritis, or SLIL iatrogenic compromise that may occur following excessive capsular excision when removing dorsal ganglion cysts.

Patients will likely present with some degree of pain although not all SLAC wrists are symptomatic. Pain is common and may be aggravated by heavy use and is sometimes associated with a clunking sensation during movement. There will usually be a decreased wrist ROM and weakness of the grip strength.

The external appearance of scapholunate instabilities may not be evident. Even in the acute phase, swelling may be moderate. When the patient presents with scapholunate advanced collapse, however, pain with provocative movements will usually be present. A scaphoid shift test is the passive mobilization of the dysfunctional scapholunate joint. This test is valuable not only in determining the presence of abnormal radioscapoid subluxation but also in reproducing the patient's pain and the reason they are presenting to the doctor. A positive scaphoid shift test is said to be diagnostic of scapholunate instability.

To perform the (Watson) scaphoid shift test, firm pressure is applied to the palmar tuberosity of the scaphoid while the wrist is moved from ulnar to radial deviation. In normal wrists, the scaphoid cannot flex because of the external pressure by the examiner's thumb. A positive test is seen in a patient with a scapholunate tear or a patient with a lax wrist. When pressure on the scaphoid is removed, the scaphoid goes back into position, and a typical snapping occurs.

A scapholunate ballottement test can also be performed. The lunate is firmly stabilized with the thumb and index finger of one hand, while the scaphoid, held with the other hand is displaced dorsally and palmarly with the other hand. A positive result elicits pain, crepitus and excessive mobility of the scaphoid.[6][8][9]

Evaluation

Imaging begins with standard PA and lateral wrist radiographs. Bilateral clenched-fist comparison views may reveal a DISI with a relative widening of the scapholunate interval on the affected side. This radiograph should be taken and appreciated acutely in the disease process as possible.

SLAC wrist will have a pattern of arthrosis which shows the progression of the injury. Localized arthrosis of the scaphoid fossa begins at the styloid tip (radial styloid beaking) which is indicative of a Stage I SLAC wrist. Progressive joint space narrowing and sclerosis affecting the entire scaphoid fossa of the distal radius is indicative of Stage II SLAC wrist. Stage III SLAC wrist entails sclerosis and joint space narrowing between the lunate and capitate. Eventually, the capitate will migrate proximally into the space created by the scapholunate dissociation. Stage III SLAC wrist is synonymous with "Terry Thomas sign." The lunate may fall into dorsiflexion (dorsal intercalated segment instability), and the scaphoid into flexion but the integrity of the radiolunate articulation is preserved until late in the process.[10]

Advanced Imaging Modalities

While CT scans are often not indicated, MRI scans may facilitate diagnosis in subtle clinical presentations. However, the latter are also often not necessary. When obtained, an MRI may reveal thinning of the articular surfaces of the

proximal scaphoid. It may also show synovitis of the scaphoid facet of the distal radius and capitolunate joint as well as the overall radiocarpal and midcarpal joints.

Treatment / Management

Treatment of scapholunate advanced collapse is difficult and not always predictable. Nonoperative treatment can include NSAIDs, wrist splints, and possible corticosteroid injections for mild disease.

Operative treatments include^{[8][11][12][13][14]}:

- Stage I SLAC wrist
 - Radial styloidectomy and scaphoid stabilization procedures
 - PIN and AIN denervation
- Stage II SLAC wrist
 - Proximal row carpectomy (PRC) is indicated to treat Stage II (but not Stage III) SLAC wrist.
 - Note that a PRC procedure is contraindicated in Stage III deformity given that this implies an element of capitolunate arthritis, and patients inevitably report inferior outcomes in this clinical scenario
- Stage III SLAC wrist
 - Scaphoid excision and four corner fusion
 - Produces reliable, positive outcomes in patients suffering from debilitating Stage II or Stage III SLAC wrist deformity
 - Outcomes are equivalent in the long-term when comparing this procedure to a PRC in Stage II SLAC wrist deformity
 - Wrist fusion
 - Indicated in the setting of Stage III SLAC wrist or pancarpal arthritis
 - Wrist fusion procedures result in positive outcomes with respect to pain relief, but wrist motion is compromised compared to scaphoid excision/four corner fusion (the latter demonstrates preserved wrist motion following surgical reconstruction via the lunate/distal radius articulation at the lunate fossa)

Differential Diagnosis

Differential diagnosis may include scaphoid fractures, distal radius fractures, dorsal ganglion cysts.

Associated injuries that may contribute to a missed diagnosis include dorsal intercalated segmental instability.

Staging

Classification is broken down to 4 stages. Stage 1 demonstrates radial styloid degenerative changes. Stage 2 is represented by degenerative changes that involve the scaphoid fossa and the styloid. Stage 3 has lunocapitate degenerative changes. Stage 4 is the last stage. Pancarpal arthritis is indicative of stage four; however, this is somewhat controversial because some surgeons do not believe scapholunate advanced collapse will result in pancarpal arthritis. Nevertheless, the radiolunate facet is always spared of arthrosis in scapholunate advanced collapse.^[15]

Prognosis

Most cases of scapholunate advanced collapse are in the beginning stages of progressive carpal destabilization around the lunate and result from an injury involving wrist hyperextension, ulnar deviation, and midcarpal supination.

Complications

Complications do exist for operative interventions and include possible infection, failure of fusion, and the need for additional procedures.[16]

Postoperative and Rehabilitation Care

After a four corner fusion, patients should be immobilized in a short-arm volar splint for 2 weeks, at which point a custom splint is worn for an additional 6 weeks or until radiographic evidence of healing is confirmed.[17]

Gentle finger range of motion and strengthening are started at 2 weeks, but wrist motion and strengthening are not initiated until there is radiographic confirmation of union.

Patients should expect a 50% loss in wrist range of motion compared with the contralateral side. Grip strength should return to about 80% of the unaffected side.

Deterrence and Patient Education

Most of these cases involve a chronic scapholunate ligament injury that has slowly progressed to collapse. In-depth conversation is necessary to have with the patient in regards to the disease process and progression of failure. Not only is this conversation important to have with patients who already have a collapse, but it is also very important to explain the consequences of not treating an acutely injured scapholunate ligament injury.

Pearls and Other Issues

Acute traumatic SLIL injuries can often be repaired despite even the most traumatic injuries resulting in an obliterated state of ligamentous integrity. In conditions caused by underlying arthritic conditions and inflammatory arthritis, the ligamentous and other pericapsular soft tissue structures are of significantly poor quality and can compromise overall healing and patient-reported outcomes.

Enhancing Healthcare Team Outcomes

Although the condition of scapholunate advanced collapse was not recognized in the early 20th century, it was not until 1972 that Linscheid and associates publicized the features.[18]

Scapholunate advanced collapse requires very strong interprofessional communication between the patient, the doctor and the hand therapists. The operations needed to treat this process are typically big procedures that will require intense hand therapy afterward. Managing patient expectations is also critical.

Questions

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