Scapholunate Interosseous Ligament Anatomy and Biomechanics

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Learning Objectives

- Discuss the anatomy and morphology of the scapholunate interosseous ligament (SLIL).
- Review SLIL kinetics and biomechanical properties.
- Appraise the biomechanical properties of the SLIL subregion.
- Compile data from current studies on the biomechanical parameters of the SLIL and its subregions.
- Assess the pathomechanics of the SLIL.

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Injury to the scapholunate interosseous ligament is one of the most common causes of carpal instability and can impart considerable compromise to the patient's hand function. However, the management of scapholunate ligament injuries remains a dynamic concept, especially with regard to the multitude of options and techniques that exist for its surgical treatment. We present a thorough review of scapholunate anatomy and morphology, and the role of the scapholunate articulations in the kinetics and pathomechanics of wrist instability. We also review the current literature on the biomechanical properties of the scapholunate ligament and

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its subcomponents. A sound understanding of the anatomy and biomechanics of the scapholunate ligament can clarify its instability and may better orient current reconstructive procedures or pioneer better future techniques. *(J Hand Surg Am. 2015;40(8):1692−1702.*

Key words Scapholunate, biomechanics, anatomy, review, ligament.

LIGAMENTOUS CROSS-CONNECTIONS between the carpals stabilize the intercarpal intervals for proper wrist kinematics.[1,2] Injuries to these wrist ligaments can contribute to carpal instability and wrist arthrosis, as evidenced by clinical conditions such as dorsal intercalated segment instability (DISI) and scapholunate advanced collapse (SLAC). Injuries to the scapholunate interosseous ligament (SLIL), situated between the scaphoid and lunate carpals, are considered the most common cause of carpal instability.[3] Unfortunately, current surgical options for the management of SLIL injuries are still far from optimal, especially for chronic SLIL injuries of unknown duration.[4] This article will review the current literature on SLIL anatomy and biomechanics as evidence for its important role in stabilizing the wrist and to lay the foundation for better understanding of management of SLIL injuries.

ANATOMY AND MORPHOLOGY

The SLIL is a C-shaped ligament situated between the scaphoid and lunate bones of the wrist (Fig. 1). The SLIL is anatomically divided into 3 segments: dorsal, proximal, and volar, with the distal edge of the scapholunate articulation free of ligamentous attachment.[5] The dorsal segment of the SLIL is the thickest and is situated between the proximal pole of the scaphoid and the dorsal portion of the lunate, with an approximate thickness of 3 mm and a proximal-distal length of 5 mm.[6] The volar segment proximally combines with the radioscapholunate ligament[7] and distally inserts on the scaphoid with small connections to the radioscaphocapitate ligament (Fig. 2A).[6,7] It is only 1 mm thick and has a proximal-distal length of 5 mm.[6] The proximal segment of the SLIL has variable thickness and is predominantly composed of fibrocartilage.

Although the SLIL is the primary stabilizer of the scapholunate joint, multiple extrinsic ligaments also attach in proximity to the scapholunate joint, acting as secondary stabilizers (Fig. 2). Dorsally, there are 2 such key extrinsic ligaments (Fig. 2B). The dorsal radiocarpal (DRC) and dorsal intercarpal (DIC) ligaments form a lateral "V" with an apex in the triquetrum that stabilizes the dorsal scapholunate interval.[8] On the palmar side, there are 3 main ligamentous stabilizers: the radioscaphocapitate (RSC), long radiolunate (LRL), and radioscapholunate (RSL) ligaments (Fig. 2A).[9,10] The importance of each of these ligaments in stability of the scapholunate joint is not yet known, although theoretically, up to 10 secondary carpal ligaments may act to stabilize the scapholunate joint.[11]

The scapholunate interval is also characterized by variable bone morphology that can affect joint mechanics.[12,13] Viegas[13] generated data on specific lunate morphologies. Currently, 2 distinct types of lunate morphologies have been identified: type I, characterized by no facet articulation with the hamate; and type II, characterized by ulnar facet articulations with the hamate.[14] There is no universally agreed-upon categorization system for scaphoid or scapholunate morphologies. Schimmerl-Metz et al[15] attempted to organize scapholunate joints into 3 distinct categories based on radiologic configuration in the coronal plane and characterized by: type I, parallel straight surfaces in the midportion of the scapholunate interval; type II, inverted Y-configuration with continuous widening of the joint space from the distal to the proximal margins; and type III, parallel and congruent surfaces that are less than 2 mm in length of the midjoint (Fig. 3). However, the clinical relevance of this classification system is unclear because as specific scapholunate morphologies have yet to be correlated with subsequent pathology.

KINETICS

During wrist flexion or radial deviation, the distal scaphoid flexes and draws the lunate into flexion through the strong SLIL (Fig. 4).[2,3] During wrist ulnar deviation, forces at the triquetral hamate articulation are transmitted through the SLIL, rotating the scaphoid and lunate into extension (Fig. 4).[2,16] The SLIL may also be critical for complex wrist movements such as the dart-throwing motion, which does not typically strain the SLIL but may depend on it for scapholunate stability during motion.[17−19] Secondary ligamentous stabilizers of the scapholunate joint can lock the intercalated proximal row in place and rotate it in a unified fashion.[2,3,20]