Acute and chronic scapholunate ligament instability

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Abstract

Injury to the scapholunate junction and ensuing carpal instability is a potentially debilitating condition affecting all ages but particularly occurring in young active individuals. The natural history of scapholunate instability is poorly understood and the link between injury and progression to advanced degeneration of carpal bones is complex. Successful surgical management of acute scapholunate instability relies on an early detection because chronic instability presents its own unique challenges. In this article we will discuss the complex anatomy, biomechanics and pathomechanics of scapholunate instability and review the current concepts of management. We have also proposed a classification system to group the surgical management options of chronic instability.

Keywords carpal instability; scapholunate instability; wrist ligament reconstruction

Introduction

Injury to the scapholunate junction and ensuing carpal instability is a potentially debilitating condition affecting primarily young active individuals. The natural history of this condition is poorly understood and the link between injury and progression to advanced degeneration of carpus is complex.

Anatomy

The wrist is not a single joint; it is a collection of several articulations, which are linked with each other in a complex kinematic relationship. The motion of every member of the eight carpal bones is governed by mechanical links from its neighbours and is restrained by a complex set of intrinsic and extrinsic ligaments.[1]

Intercalated segment

The scaphoid, lunate and triquetrum in the proximal row are together described as an intercalated segment. These bones have no tendon attachments and lie between bones which do have tendon attachments; thus very little direct control is exerted over the proximal carpal row.[2]

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Distal carpal row

The hamate, capitate, trapezoid and trapezium are strongly bound together by stout interosseous ligaments and negligible motion occurs between them. They are considered as a rigid unit and are controlled by musculotendinous forces from the forearm.[1]

The scapholunate interosseous ligament (SLIL)

This is a true intra-articular ligament with three distinctly defined anatomical and histological components.[3] It is C-shaped and acts as the primary stabilizer of the scapholunate joint. The three components are dorsal, intermediate and volar.

The dorsal component is the strongest and thickest, with a maximal tensile strength of 300 N. This is the most critical stabilizer, acting as a primary restraint against distraction and torsional moments.[4]

The intermediate component is the weakest link and is made of fibrocartilage, offering very little tensile strength with a maximum of 25−50 N.

The volar component is also a true ligament, offering a maximal tensile strength of 150 N, providing restraint against rotational moments. It also has a proprioceptive role.[5] Being an intra-articular ligament, the SLIL is enclosed in synovium and has very poor healing abilities, somewhat analogous to the anterior cruciate ligament in the knee joint (see Figure 1).

Secondary stabilizers of the scapholunate joint

Several ligaments confer secondary restraint to the scapholunate joint. These ligaments, when individually compromised, do not cause instability but when combined with SLIL insufficiency can accelerate progressive instability. Dorsally, there is a unique V-shaped arrangement between the dorsal intercarpal (DIC) and dorsal radiotriquetral (DRC) ligaments, conferring important secondary stability.[6] Volarly radioscaphocapitate, long and short radiolunate and the scaphotrapezial trapezoid (STT) ligamentous complex are the important secondary restraints. The radioscapholunate, or ligament of Testut, is no longer considered as important as it was, as a recent study confirms that it is indeed simply a vascular conduit. The STT ligament complex, particularly the palmar ligament complex comprising the floor of the sheath of flexor carpi radialis (FCR) is considered as the most important secondary stabilizer to prevent rotatory subluxation of scaphoid[7] (see Figures 2 and 3).

There is an inbuilt redundancy in scapholunate stabilization. An isolated injury to SLIL, and even complete division, results in dynamic instability but does not cause static changes in scapholunate gap or lateral scapholunate angle.[1] Static changes require failure of the secondary stabilizers. After an initial injury to the SLIL, secondary stabilizers undergo attritional wear and this explains the delayed development of dorsal intercalated segmental instability (DISI) changes.

Progressive rotatory subluxation of scaphoid is the hallmark of DISI. This alters the loading kinetics of the radioscaphoid joint. In a cadaveric study it was observed that 20° of scaphoid subluxation caused 77% reduction in contact surface area, shifting the load to the dorsal lip of the scaphoid fossa of the radius.[8,9] This explains why scapholunate advanced collapse (SLAC) causes arthritis at the radioscaphoid joint but not at the radiolunate joint.[9]

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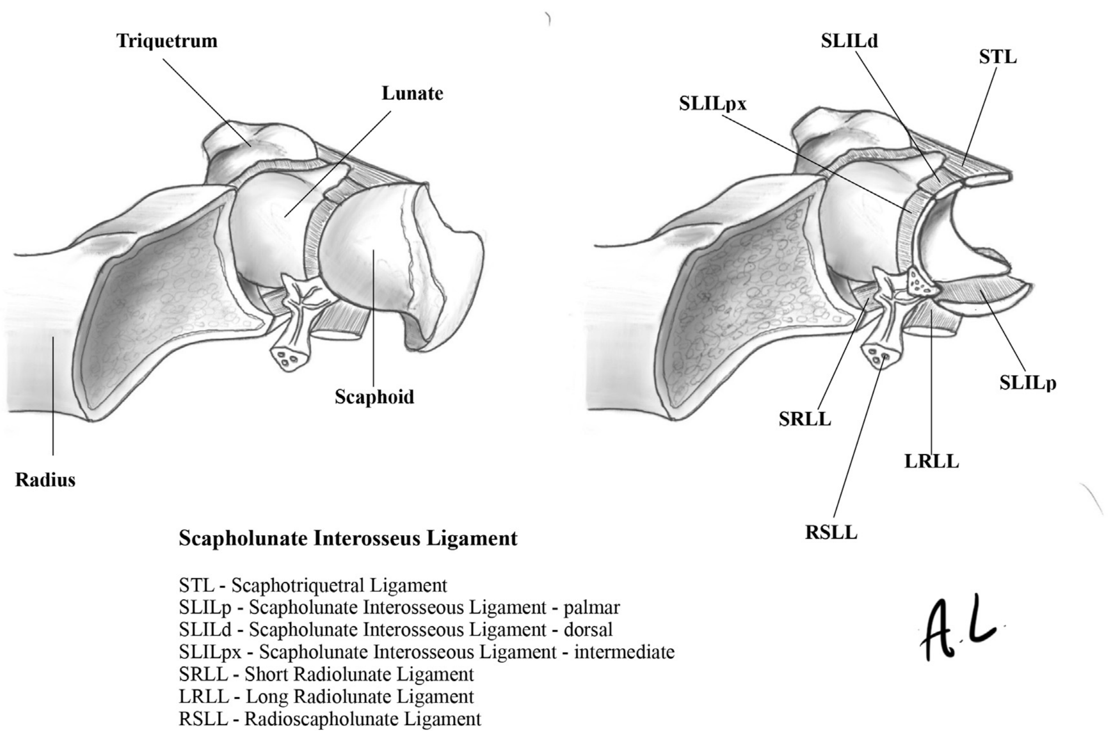

Figure 1 Macrostructure of scapholunate interosseous ligament. Image drawn by Alice Lacey.

Kinetics

SLIL integrity is essential for normal wrist kinetics. During wrist radial deviation the distal scaphoid flexes, exerting a flexion moment on the lunate through the SLIL. During wrist ulnar deviation the triquetral-hamate articulation exerts an extension moment on scaphoid and lunate through SLIL. SLIL and secondary stabilizers also lock the proximal intercalated row to produce unified motion during the 'dart thrower's' motion (ulnar flexion to radial extension). This concept is useful for rehabilitation of scapholunate injury.

Natural history

This is the most poorly understood aspect of this injury. Recent evidence suggests that variability of radioscaphoid articular anatomy makes it difficult to predict the path of disease progression in scapholunate instability.[10] O'Meeghan et al.,[11] in

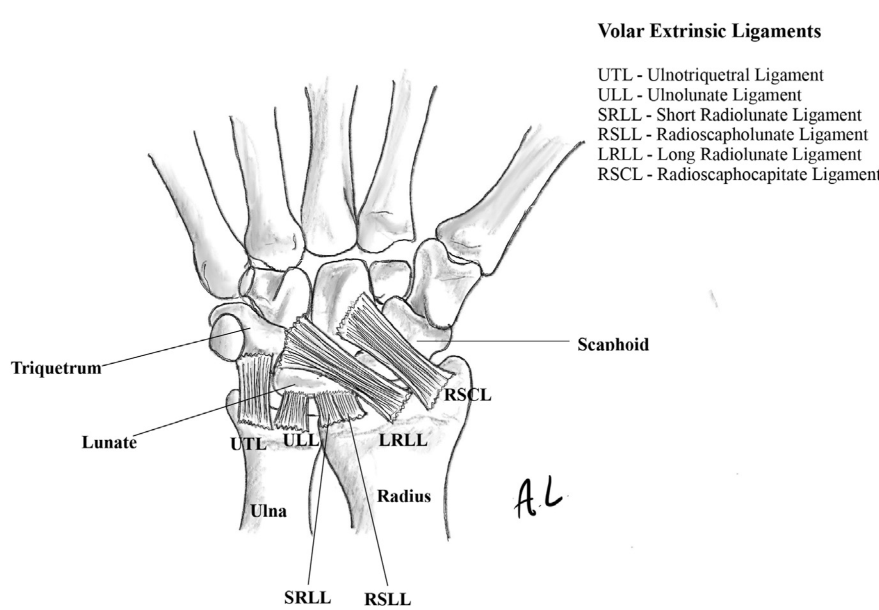

Figure 2 Volar extrinsic stabilizers. Image drawn by Alice Lacey.

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