Physical Examination of the Wrist: Useful Provocative Maneuvers

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Chronic wrist pain resulting from partial interosseous ligament injury remains a diagnostic dilemma for many hand and orthopedic surgeons. Overuse of costly diagnostic studies including magnetic resonance imaging, computed tomography scans, and bone scans can be further frustrating to the clinician because of their inconsistent specificity and reliability in these cases. Physical diagnosis is an effective (and underused) means of establishing a working diagnosis of partial ligament injury to the wrist. Carefully performed provocative maneuvers can be used by the clinician to reproduce the precise character of a patient's problem, reliably establish a working diagnosis, and initiate a plan of treatment. Using precise physical examination techniques, the examiner introduces energy into the wrist in a manner that puts load on specific support ligaments of the carpus, leading to an accurate diagnosis. This article provides a broad spectrum of physical diagnostic tools to help the surgeon develop a working diagnosis of partial wrist ligament injuries in the face of chronic wrist pain and normal x-rays. *(J Hand Surg Am. 2015;40(7):1486−1500. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Carpus (wrist), physical examination, ligament injuries, provocative maneuvers, anatomy.

Over the past half-century, a plethora of clinical and laboratory research has been published on the kinesiology and biomechanics of the wrist joint. Gross and micro cadaver dissections have elucidated details of wrist anatomy; sophisticated imaging studies have clearly defined mechanisms of carpal motion; and mechanical studies under load-to-failure conditions have contributed to a deeper understanding of the carpus, including small aggregates of motion among carpals that allow the wrist to function like a ball-and-socket joint.

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PATHOMECHANICS OF CARPAL LIGAMENT INJURY

The complex nature of carpal mechanics can be simplified by considering the distal carpal row (trapezium, trapezoid, capitate, and hamate) as securely attached to the medial 4 metacarpals through short, tight, intrinsic ligaments. The distal row moves with the hand as a single unit. The proximal carpal row (scaphoid, lunate, and triquetrum) can be considered a single free-body, intercalated between the hand (including the distal row) and the forearm, suspended by extrinsic radiocarpal and intrinsic intercarpal ligaments (Fig. 1). As the hand−forearm unit moves the wrist, the position of the intercalary proximal row shifts at the radiocarpal joint (relative to the forearm) and at the midcarpal joint (relative to the hand), similar to a ball-and-socket joint. The carpal mechanism depends on the health and integrity of the intrinsic and extrinsic ligaments to guide bony relationships among the 7 critical carpals (pisiform excluded).

Carpal alignment at rest is maintained with considerable stored potential energy and, by definition, a

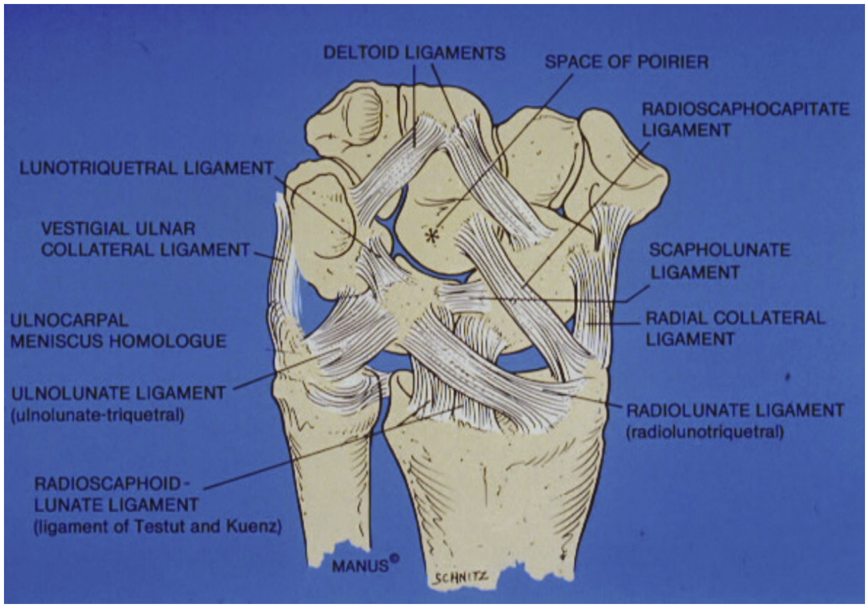

FIGURE 1: The proximal carpal row, consisting of scaphoid, lunate, and triquetrum, is suspended as an intercalated segment between the hand (distal carpal row) and forearm (radius and ulna). Major palmar ligaments serve as struts and guy-wires that allow the proximal row to move as a free body in space between the hand and forearm. By changing its position between the moving hand and forearm, the wrist behaves like a ball and socket, generating a full arc of circumduction by small aggregates of motion from each intercarpal joint.

predisposition of the carpus to collapse into a more stable but less physiologic attitude. Ligamentous struts and guy wire mechanisms maintain the longitudinal axis of the scaphoid at about 47° relative to the longitudinal axis of the hand–forearm unit (Fig. 2).[1] A neutral position of the lunate is maintained through its secure attachment to the proximal scaphoid pole by the scapholunate (SL) interosseous ligament. Separated from the palmar-flexing influence of the scaphoid, the lunate is predisposed to collapse into extension (Fig. 3). In physics terms, "carpal instability" is a misnomer. Whereas healthy ligaments maintain normal carpal alignment, their failure either by injury or disease will result in predictable patterns of carpal collapse into physically more stable but less physiologic relationships.

Anatomic carpal alignment (stored potential energy and predisposition to collapse) is a prerequisite for healthy wrist biomechanics. Loss of ligament support by injury or disease dissipates potential energy as kinetic energy and results in collapse of the carpus. Inherent in carpal collapse is either subtle or overt disintegration of healthy bony alignment of the components of the intercalated proximal row. Dissipation of kinetic energy, collapse of the carpus, and reorientation of articular surfaces result in surface cartilage shear. Hyaline cartilage loss from chronic shear forces leads to painful degenerative arthritis.

Normally, hyaline cartilage surfaces are apposed in compression along a principal axis of load bearing regardless of the position of the hand relative to the forearm. (The principal axis is an engineering term used to define an imaginary point at the center of an infinite number of cluster points between 2 loaded surfaces in contact with each other.) The principal axis of load bearing across the carpus constantly shifts as the hand circumducts. The intercalated proximal row translates and rotates to maintain surface cartilage contact in compression mode, guided by healthy ligaments. Alignment of surface cartilage in compression mode allows the wrist to function painlessly like a ball and socket. Ligament damage that allows carpal collapse (dissipation of stored potential energy) will result in a wrist that is physically more stable, but with joint surfaces aligned in shear rather than compression, and eventual pain from synovitis and cartilage loss.

An example is static SL dissociation (Fig. 4). A healthy SL interosseous ligament normally prevents separation and malrotation of the scaphoid and lunate relative to each other. Without structural integrity of the SL ligament, the scaphoid will collapse from its approximately 47° attitude into a position relatively more perpendicular to the longitudinal axis of the hand–forearm unit. Scapholunate separation results in lunate extension into dorsiflexion intercalated segment

Current Concepts