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Dynamic high-resolution ultrasound of intrinsic and extrinsic ligaments of the wrist: How to make it simple

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ABSTRACT

Wrist ligaments are crucial structures for the maintenance of carpal stability. They are classified into extrinsic ligaments, connecting the carpus with the forearm bones or distal radioulnar ligaments, and intrinsic ligaments, entirely situated within the carpus. Lesions of intrinsic and extrinsic ligaments of the wrist have been demonstrated to occur largely, mostly in patients with history of trauma and carpal instability, or rheumatoid arthritis. Ultrasound allows for rapid, cost-effective, non-invasive and dynamic evaluation of the wrist, and may represent a valuable diagnostic tool. Although promising results have been published, ultrasound of wrist ligaments is not performed in routine clinical practice, maybe due to its technical feasibility regarded as quite complex. This review article aims to enlighten readers about the normal sonographic appearance of intrinsic and extrinsic carpal ligaments, and describe a systematic approach for their sonographic assessment with detailed anatomic landmarks, dynamic manoeuvres and scanning technique.

1. Introduction

Intrinsic and extrinsic ligaments of the wrist stabilize the carpal bones during movement, acting as a guide with respect to the forearm bones and metacarpals, and transmitting motion from one carpal bone to another [1,2]. They are intracapsular, extrasynovial structures, termed for the origin and insertion bones, proximal to distal and radial to ulnar. Extrinsic ligaments connect the carpus with the forearm bones or distal radioulnar ligaments; intrinsic ligaments are entirely situated within the carpus and connect adjacent bones within the proximal or distal row (interosseus ligaments), or pass over the midcarpal joint (midcarpal ligaments). However, the edges of intracapsular wrist ligaments may not be distinct or discrete as their fibers appear to blend one into another [3,4].

Lesions of wrist ligaments have been demonstrated to occur largely, mostly in patients with history of wrist trauma and carpal instability [5,6]. In the setting of acute trauma, the prevalence of extrinsic and intrinsic ligament injury has recently been reported as 75% and 60%, respectively, being higher in case of concomitant osseous lesions [6]. Carpal ligament abnormalities may also occur as a result of chronic, progressive diseases, such as rheumatoid arthritis [7]. Initial symptoms include wrist discomfort, grip weakness, and click phenomena, and may progress to restriction of range of motion and finally to osteoarthritis [8–11]. Early diagnosis is crucial to ensure optimal clinical management. Arthroscopy is regarded as the reference standard, but it is invasive and may be complicated by injuries of adjacent tendons, nerves, and vessels [12]. Thus, imaging plays an essential role in the evaluation of wrist ligaments. Since these ligaments are anatomically and functionally linked to the adjacent bones, symptomatic or disabled wrist should be first examined with plain radiography, which gives information on the osseous structures [13]. Magnetic resonance (MR) imaging [14–23] and MR arthrography [24–27] are effective tools

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Table 1
Sequential protocol to perform dynamic ultrasound evaluation of wrist ligaments.

Steps	Ligaments	Standard scans	Wrist position
1	Palmar radiocarpal	Longitudinal-to-oblique (from radial to ulnar)	Supination ± extension
2	Palmar ulnocarpal	Longitudinal-to-oblique (from ulnar to radial)	Supination ± extension
3	Palmar midcarpal	Transverse	Supination ± extension
4	Palmar interosseous	Transverse	Supination ± extension
5	Dorsal radiocarpal	Oblique	Pronation ± flexion
6	Dorsal midcarpal	Transverse-to-oblique	Pronation ± flexion
7	Dorsal ulnocarpal	Longitudinal	Pronation ± flexion
8	Dorsal interosseous	Transverse	Pronation ± flexion
9	Radial collateral	Longitudinal	Pronation ± ulnar deviation
10	Ulnar collateral	Longitudinal	Pronation ± radial deviation

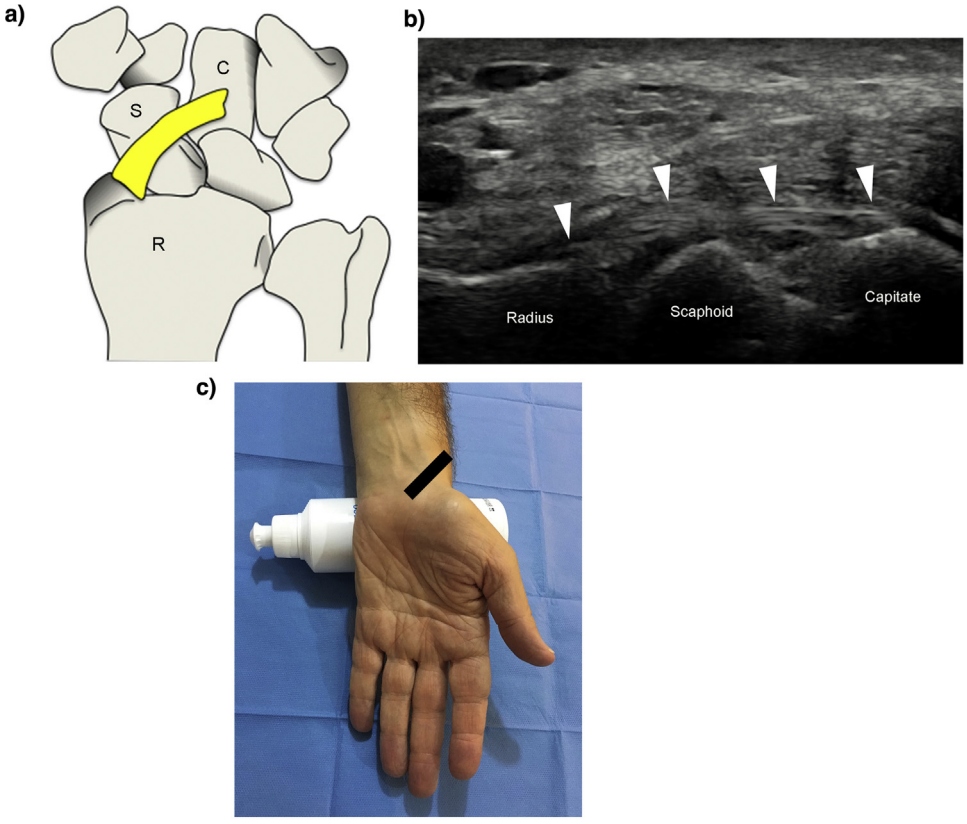

Fig. 1. Radioscaphocapitate ligament. This ligament arises at the palmar aspect of the distal radius, from the radial styloid to approximately the middle of the scaphoid fossa, and attaches to the scaphoid and capitate. (a) Schematic drawing of the radioscaphocapitate ligament anatomic structure: the ligament is shown in yellow. R, radius; S, scaphoid; C, capitate. (b) US scan of the radioscaphocapitate ligament (arrowheads). (c) Probe positioning on the volar wrist, with the wrist in supination and slight extension.

in the evaluation of ligaments around the wrist and also have the ability to demonstrate concomitant intra-articular abnormalities, joint effusion and bone marrow oedema. However, they are relatively expensive and burdened by artefacts if metallic implants are present; further, they are often unavailable in the context of acute trauma. Promising results have been published on ultrasound (US) of carpal ligaments [28–38], and according to Renoux et al. this examination should precede MR imaging and MR arthrography in the diagnostic algorithm of painful or disabled wrist [35]. Currently, US of carpal ligaments is not performed in routine clinical practice, maybe due to its technical feasibility considered as quite complex. Doubtless, more energy should be invested in this diagnostic tool that is inexpensive and largely available and, more importantly, allows for addressing the clinical question quickly with a focused examination of the injured structure. This review article aims to: (i) enlighten readers about the normal sonographic appearance of intrinsic and extrinsic carpal ligaments; and (ii) describe a systematic approach for US assessment of intrinsic and extrinsic carpal ligaments with detailed anatomic landmarks, dynamic manoeuvres and scanning technique. A systematic search of the literature was carried out in PubMed and included articles in English language focusing on role of ultrasound in the assessment of intrinsic and extrinsic ligaments of the wrist. All studies involving patients declared to have obtained informed consent and approval by an institutional review board.

2. General principles of US examination

Intrinsic and extrinsic ligaments of the wrist consist of bundles of parallel-oriented type I collagen fibers and show a fibrillar pattern at US examination [28,33,39]. The US beam must be directed as perpendicular as possible to the evaluated structure in order to avoid anisotropy, an artifactual decrease in echogenicity that may be misinterpreted as a pathological change [40–43].