

EURO-MUSCULUS/USPRM Dynamic Ultrasound Protocols for Wrist and Hand

Kamal Mezian¹, Vincenzo Ricci², Orhan Güvener³, Jakub Jačisko⁴, Tomáš Novotný⁵,
Murat Kara⁶, Ayşe Merve Ata⁷, Wei-Ting Wu^{8,9}, Ke-Vin Chang^{8,9}, Carla Stecco¹⁰,
Carmelo Pirri¹⁰, Gürsel Leblebicioğlu¹¹, Levent Özçakar⁶

¹Department of Rehabilitation Medicine, First Faculty of Medicine and General University
Hospital, Charles University, Prague, Czech Republic

²Physical and Rehabilitation Medicine Unit, Luigi Sacco University Hospital, ASST
Fatebenefratelli-Sacco, Milan, Italy

³Department of Physical and Rehabilitation Medicine, Mersin University Medical School,
Mersin, Turkey

⁴Department of Rehabilitation and Sports Medicine, Second Faculty of Medicine, Charles
University and University Hospital Motol, Prague, Czech Republic

⁵Department of Orthopaedics, University J.E. Purkyne, Masaryk Hospital, Usti nad Labem,
Czech Republic

⁶Department of Physical and Rehabilitation Medicine, Hacettepe University Medical School,
Ankara, Turkey

⁷Department of Physical Medicine and Rehabilitation, Doctor Ayten Bozkaya Spastic Children,
Hospital and Rehabilitation Center, Bursa, Turkey

⁸Department of Physical Medicine and Rehabilitation, National Taiwan University Hospital, Beitou Branch, Taipei, Taiwan

⁹Department of Physical Medicine and Rehabilitation, National Taiwan University College of Medicine, Taipei, Taiwan

¹⁰Department of Neurosciences, Institute of Human Anatomy, University of Padova, Padova, Italy

¹¹Hacettepe University Medical School, Department of Orthopaedics and Traumatology, Hand Surgery Unit, Ankara, Turkey

Corresponding Author

Vincenzo Ricci, MD

Physical and Rehabilitation Medicine Unit, Luigi Sacco University Hospital,

ASST Fatebenefratelli-Sacco, Milan, Italy

E-mail: vincenzo.ricci58@gmail.com

ORCID ID: 0000-0003-2576-2039

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ABSTRACT

In this dynamic protocol, ultrasound evaluation of the wrist and hand is described using various maneuvers for relevant conditions. Scanning videos are coupled with real-time patient examination videos. The authors believe that this practical guide - prepared by the international consensus of several experts - will help musculoskeletal physicians perform a better and uniform/standard examination approach.

KEY WORDS

Finger, ultrasonography, tendon, maneuver, Physical and Rehabilitation Medicine

The utility of musculoskeletal ultrasound (US) has already become a routine in the daily clinical practice of physiatrists. As an extension of basic/static scanning, dynamic assessment is a critical advantage of this examination technique. However, protocols for implementing this method in the wrist and hand do not exist in the literature. Like the previous basic scanning protocols in physical and rehabilitation medicine,¹⁻³ an international group of experts also prepared this guide for dynamic assessment of wrist and hand disorders.

DORSAL ASPECT OF THE WRIST

Radiocarpal joint

Technique

The patient should sit face to face with the examiner keeping the hand in palm down position, resting on an examination bed or the patient's ipsilateral knee, while the forearm is pronated and the elbow is semi-flexed at about 90°. The transducer is placed along the long axis of the wrist. Bony prominences serve as anatomic landmarks for both orientation and evaluation of the joint stability. The authors also suggest placing a support underneath the patient's wrist or positioning the wrist over the edge of the examination bed/table i.e. to have mild volar flexion.

Clinical Indications

Radiocarpal joint effusion: Dynamic scanning allows better visualization of the radiocarpal joint effusion. With the patient's hand in a palm down position, the wrist joint is slowly bent (dorsal/palmar) while resting on the examination table. This dynamic assessment is commonly performed in the long axis view, at the level of the lunate bone. During the maneuver, it is possible to observe that the radiocarpal joint recess is stretched with palmar flexion and

compressed while the wrist is dorsally flexed (**Figures 1A, 1B, 1C and Video 1**, <http://links.lww.com/PHM/B597>). Of note, mild effusion/synovial hypertrophy can be missed during static scanning of the wrist in neutral position or dorsal flexion. Likewise, differentiating between synovial proliferation and effusion can also be challenging with only static imaging. Further, loose bodies (e.g. cartilage or bony fragments) inside the joint can be better identified during dynamic scanning. As such, using these passive wrist flexion/extension maneuvers will potentially help elucidate the presence of all aforementioned conditions (**Video 2**, <http://links.lww.com/PHM/B598>).

Triangular fibrocartilage complex (TFCC) injuries: For dynamic examination of the TFCC, the probe is placed over the extensor carpi ulnaris (ECU) tendon along its long axis. The radioulnar deviation allows evaluation of the fibrocartilage disc with its attachment site to the distal radius and, of the meniscus homologue (**Figures 1D, 1E and Video 3**, <http://links.lww.com/PHM/B599>). Using ulnar and radial deviations, the stress test can reveal fluid being penetrated within the TFCC as an apparent cleft opening towards its inside (indicating a tear) (**Videos 4 and 5**, <http://links.lww.com/PHM/B600>, <http://links.lww.com/PHM/B601>). The fluid can also derive from the radiocarpal joint and/or the distal radioulnar joint (**Figure 1E**). In some cases, a larger gap can also be observed between the proximal carpal bones and the ulna during radial deviation.^{4,5}

Distal radioulnar joint (DRUJ) instability: For dynamic assessment, the examiner applies a squeezing force to the interosseous membrane at midforearm level, placing the thumb on the dorsal aspect while the remaining fingers are placed on the volar aspect of the forearm.⁶ At the same time, the physician uses his other hand to place the US probe in short axis view over the

distal forearm, visualizing the Lister tubercle on one side and the apex of the ulna styloid on the other side of the US screen (**Video 6**, <http://links.lww.com/PHM/B602>). When abnormal, the diastasis is associated with the distraction of the aforementioned bony landmarks (**Figure 1F and Video 7**, <http://links.lww.com/PHM/B603>). The contralateral side can, for sure, be used as the reference.⁵ DRUJ instability can be congenital (in patients with laxity of the capsuloligamentous structures), or be related to chronic overloads of the wrist, or can be post-traumatic. Particularly, in patients with post-traumatic instability (a high-grade instability), during the dynamic maneuver and the squeezing phase of the technique, the diastasis of bones is associated with a bulging of the dorsal aspect of the synovial membrane - due to dynamic flow of the intra-articular effusion.

Carpal bones and ligaments

Technique

The patient sits in front of the examiner with the palm down, the forearm pronated, and the elbow flexed at about 90°. The palmar and dorsal aspects are used to visualize the bony surfaces of the radius, ulna, and carpal bones, and the ligaments that interconnect the above structures. Initially, the transducer is positioned on the Lister tubercle when scanning from the dorsal aspect and then it is advanced distally toward the fingers. Smooth surfaces of the individual carpal bones can be identified, forming the proximal and distal rows, together with the intrinsic and extrinsic ligaments.

Systematic scanning from the palmar side starts at the distal wrist crease. Moving the transducer distally, the scaphoid tubercle and the pisiform bone can be observed bridging the carpal tunnel. Two important bony landmarks can be observed when advancing the probe further towards the

fingers; the trapezium tubercle and the hook of the hamate. Relocating the probe along the fingers, individual metacarpal bones can also be identified.

US allows a comprehensive assessment of the extrinsic and intrinsic wrist ligaments as hyperechoic bands connecting the individual bones.⁷ It is essential to direct the sound beam as perpendicular as possible to avoid anisotropy artifact that can otherwise be misinterpreted as a pathology (e.g. edema, tear). A ligament tear is suspected if the fibers are discontinuous or the ligament is absent. Additionally, corresponding cortical irregularity and/or ligament thinning should also caution the examiner. Herein, dynamic examination will allow for better visualization of the ligament stability (**Videos 8 and 9**, <http://links.lww.com/PHM/B604>, <http://links.lww.com/PHM/B605>).⁸ One can either apply stress to the joint in order to generate tension on the ligaments or directly compress with the probe. Separation of the (torn) ends or penetration of the overlying superficial tissues towards the joint would be the relevant findings for instability and/or rupture. For sure, dynamic testing may also reveal an impingement due to ligament tear/instability.⁹

Clinical Indications

Scapholunate ligament dysfunction: The transducer is first placed in the short axis view over the radiocarpal joint on the distal forearm (dorsal side). While the probe is being moved distally, the two bony structures on the screen will represent scaphoid and lunate. A V-shaped hypoechoic area is apparent between these two bones, while the gap (hypoechoic area) in the scapholunate joint is filled with the dorsal portion of the scapholunate ligament. The ligament can be stressed dynamically by moving the patient's wrist into ulnar deviation and any increase in the width

between the two bones can be checked (**Figure 1G**) for scapholunate dissociation.¹⁰ Aside from their diastasis, common sonographic findings also include penetration of synovial fluid through a focal gap of the ligament (**Video 10**, <http://links.lww.com/PHM/B606>) and abnormal movements of a small bony fragment in case of post-traumatic avulsion. Alternative maneuvers to mechanically stress the ligament - i.e. (de)tensioning - would be opening/closing the fist and palmar/dorsal flexions of the wrist.

Scaphoid fracture: The scaphoid bone should optimally be scanned in short/long axis while the wrist is positioned in ulnar deviation. The typical finding for fracture is discontinuity of the bony cortex. Indirect signs are radiocarpal hemarthrosis and scapho-trapezium-trapezoid effusion.¹¹ Needless to say, nearby soft tissues changes, such as callus formation, can easily be detected by US examination.¹² The sonographer can also apply stress tests to check for the (in)stability of the fracture and/or callus. Dynamic maneuvers using passive movements can demonstrate fracture non-union with apparent motion between the two bone fragments.¹³

Extensor tendons

Technique

The patient sits in front of the examiner with the palm down, the forearm pronated, and the elbow flexed at 90°. The probe is placed at the level of the distal radioulnar joint over the Lister tubercle which is the bony landmark that separates the 2nd and 3rd compartments. Sliding the probe towards the ulnar/radial side, all six extensor compartments can be systematically evaluated. Dynamic scanning allows evaluation of tendon glidings beneath the extensor retinaculum and within the tendon sheaths (**Figure 2**). Active/passive flexion and extension of

the fingers will prompt integrity of the normal appearing hyperechoic tendons from proximal to distal as necessary. Likewise, intersections syndromes - i.e. either the 1st compartment crossing over the 2nd proximally or the 3rd one crossing over the 2nd distally - can also/thoroughly be examined (**Video 11**, <http://links.lww.com/PHM/B607>).¹⁴

Clinical indications

Extensor retinaculum impingement: During the active movement (e.g. flexion/extension of the fingers and radial/ulnar deviation of the wrist) (**Video 12**, <http://links.lww.com/PHM/B608>), it is possible to identify the location of a mechanical conflict between the extensor tendons and the retinaculum (**Figure 2 and Video 13**, <http://links.lww.com/PHM/B609>). In some cases, the thickened retinaculum can mimic trigger finger symptoms whereby dynamic US examination would definitely be contributory.^{15,16} Similar to other conditions, if a mass or bone fragment is present at this location, dynamic scanning can also explain the exact causal relationship between the pathology and the patient's complaint.

Subluxation of the extensor carpi ulnaris tendon (ECU): During forearm pronation and supination, scanning can be performed in the short axis view where the tendon is located within its subsheath - separate from the common extensor retinaculum (**Figure 2 and Video 14**, <http://links.lww.com/PHM/B610>). ECU instability can be diagnosed if the tendon is slipping out of the ulnar groove in a volar-ulnar direction during supination and relocating during pronation of the forearm (**Figure 3A and Video 15**, <http://links.lww.com/PHM/B611>). The dislocation can be accompanied by a click sound over the wrist's dorsoulnar aspect.¹⁷ It is

noteworthy that increased mobility of the tendon can also be a normal variation, e.g. if it resides in a shallow groove.¹⁸

De Quervain tenosynovitis (DQT): From the basic position over Lister's tubercle, the transducer is shifted radially to depict the 1st extensor compartment which harbors abductor pollicis longus (APL) and extensor pollicis brevis (EPB) tendons. Sonographic findings of DQT include thickening of the extensor retinaculum and/or tendons and their synovial sheath. Attention should also be paid during the US examination for septa that would cause further compartmentalization and/or extra terminal attachments of the tendons (**Video 16**, <http://links.lww.com/PHM/B612>). These conditions might predispose to DQT due to increased friction. Dynamic US examination during thumb extension can reveal snapping phenomena pertaining to an uneven excursion of the EPB subcompartment¹⁹ or the gliding EPB over the accessory APL tendon.²⁰

Dorsal wrist ganglion: Ganglia are common pathologies at the dorsal wrist where dynamic US evaluation helps determine their origins e.g. joint, nearby tendon sheath. In particular, the articular ganglion shows limited excursion due to its connection with the dorsal joint recess and, in the latter case, the ganglion displays consensual gliding with the extensor tendon.²² Similarly, as ganglia can expand between the extensor compartments, their relationship can promptly be uncovered to explain the complaint(s) of the patient (e.g. snapping ganglion during ulnar/radial deviation of the wrist).²¹ Lastly, the examiner can also assess the ganglion cyst compressibility before considering an aspiration or planning for the appropriate technique (**Video 17**, <http://links.lww.com/PHM/B613>). Needless to say, hypo/anechoic appearing accessory muscles

of the hand should not be misdiagnosed as ganglia and dynamic imaging would again/also be contributory for such a differential diagnosis (**Video 18**, <http://links.lww.com/PHM/B614>).

VOLAR ASPECT OF THE WRIST

The patient sits opposite to the examiner with the hand in a palm up position, resting on an examination bed or a pillow, the forearm supinated, and the elbow semi-flexed at 90°. The transducer is placed along the short axis view on the volar aspect of the wrist to visualize the median and ulnar nerves and the flexor tendons. For sure, the palmar longitudinal window can also be used. During dynamic imaging, active/passive flexion and extension of the fingers is commonly performed whereby flexor tendons' integrity and gliding patterns are examined. Additionally, structure/mobility of the median nerve as well as the palmar aponeurosis can also be evaluated.

Clinical indications

Carpal tunnel syndrome (CTS): Median nerve mobility is likely to be reduced in patients with CTS.^{23,24} Dynamic scanning on the short axis view allows visualization of the mobility of the median nerve while the patient fully flexes the fingers (by slowly making a fist). The grade of its axial mobility at the carpal tunnel can be classified as follows: Grade 0 (decreased) refers to minimal movement of the median nerve; Grade 1 (slightly decreased) refers to freely moving median nerve in the transverse plane which does not dive deep toward the flexor tendons; and Grade 2 (normal) refers to freely moving median nerve between the flexor tendons (**Video 19**, <http://links.lww.com/PHM/B615>, and **Figures 3B, 3C**).²⁵ Further, dynamic scanning in the transverse plane (during finger flexion/extension) allows differentiation of tendinous structures from synovitis. Importantly, due to anatomical continuity between epimysium and the paraneural

sheath, transverse displacement of the median nerve can also be reduced at the mid-forearm level in CTS patients.²⁶ Likewise, impaired longitudinal excursion of the nerve has also been reported in CTS.²⁷

Accessory muscles: Dynamic US examination can reveal accessory muscles that might compress the adjacent nerves (**Video 20, <http://links.lww.com/PHM/B616>**).²⁸ For instance, an anomalous muscle belly of the flexor digitorum superficialis of the index finger can be observed compressing the median nerve during finger flexion and extension.²⁹ Another common accessory muscle in the wrist and hand area is the abductor digiti minimi, which runs through the Guyon canal - causing ulnar nerve compression. When the patient abducts the little finger, increase in the muscle thickness as well as nerve impingement can be observed.³⁰ During the dynamic technique, an eventual intrusion of the lumbrical muscles can also be observed within the carpal tunnel (**Video 21, <http://links.lww.com/PHM/B617>**).

HAND AND FINGERS

The patient sits face-to-face with the examiner in different positions, depending on the hand/finger aspect studied. On the dorsal side, attachments of the extensor tendons can be visualized. Flexor tendons (**Videos 22 and 23, <http://links.lww.com/PHM/B618>, <http://links.lww.com/PHM/B619>**), annular pulley system and volar plates can be evaluated on the volar side of the fingers. Each tendon needs to be scanned in short and long axes - also followed until its insertion. Dynamic maneuvers e.g. passive/active finger flexion and extension, valgus/varus stress tests, resisted flexion/extension can easily be performed. In certain cases (e.g.

finger deformities), the examination inside a water basin can be beneficial to optimize the imaging quality.

Clinical indications

Midcarpal instability: Dynamic US evaluation can clarify the painful triquetral catch-up clunk, most commonly present with ulnar deviation. Examination is carried out both during pronation and supination. The patient performs radial and ulnar duction, while the examiner holds the patient's fingers and follows the screen for clunks produced by translocation of the proximal carpal bones.³¹

Dupuytren contracture (DC): In some cases, dynamic techniques can help in the differential diagnosis of Dupuytren contracture;³² including trigger finger, tenosynovitis, ganglion, dermoid cyst and soft tissue masses.³³ In the early phase of DC, the tendons are seen to move smoothly below the palmar fibromatosis (**Video 24, <http://links.lww.com/PHM/B620>**).³⁴ In later stages, the adhesion of the nodules to the tendons (due to their mutual cord-like attachments) can be visualized under dynamic imaging.³⁵

Gamekeeper's thumb (Skier's thumb or Stener lesion): Dynamic stress can be applied to evaluate the integrity of the ulnar collateral ligament (UCL) of the metacarpophalangeal (MCP) joint of the thumb.³⁶ The palm down position of the hand on the examination table will allow access to the radial aspect of the thumb which is optimal for UCL imaging. Alternatively, the injured thumb grips a bottle while the examiner's free hand performs a valgus stress test (**Video 25, <http://links.lww.com/PHM/B621>**) - checking for an increase in the distance between the

proximal phalanx and the 1st metacarpal bone (**Figure 3D**). An intact UCL is best seen longitudinally on the radial side of the 1st MCP joint. Dynamic maneuver using valgus stress to the MCP joint can be applied to classify the injury into a nondisplaced UCL tear or a Stener lesion (**Video 26**, <http://links.lww.com/PHM/B622>). Normally, a limited joint gap opening and tensioning of the UCL is to be observed.³⁶ If painful, local anesthesia (e.g. vapor coolant spray) can be used during the test. Needless to say, these dynamic tests should be performed gently i.e. avoiding conversion of a nondisplaced injury into a Stener lesion.³⁷

Trigger finger: The patient is seated face to face with the examiner, keeping the affected hand in a palm up position. Enough US gel (alternatively stand-off pad or water filled basin) can allow minimal probe pressure and maintain contact with the finger during dynamic scanning. The transducer is placed along the long axis of the finger to visualize the flexor tendons as hyperechoic fibrillar bands superficial to the metacarpals/phalanges. Annular pulleys are seen as hypoechoic thickening of (the volar aspect of) the tendon sheath. Thickening and hypervascularization of the A1 pulley (most commonly) are the hallmarks of trigger fingers on sonography.³⁸ Herewith, dynamic examination during flexion/extension of the finger should be performed to evaluate the gliding of the tendon beneath the pulley system (**Figure 3E**, **Videos 27 and 28**, <http://links.lww.com/PHM/B623>, <http://links.lww.com/PHM/B624>). This examination might give a better insight regarding the exact cause/site of triggering (not always at the A1 pulley level).^{39,40} Aside from pulley swelling/thickening or effusion inside the synovial sheath, tendon thickening and abnormal tendon motions associated with friction patterns are other typical US findings (**Video 29**, <http://links.lww.com/PHM/B625>).⁴¹ In some cases, triggering due to swelling of other pulleys can also be observed during dynamic imaging (**Videos 30 and**

31, <http://links.lww.com/PHM/B626>, <http://links.lww.com/PHM/B627>). Of note, differential diagnosis for trigger finger - e.g. fibrous scar due to tendon rupture, tendon sheath tumors, ganglia and exostoses - can be identified using (dynamic) US as well.⁴²

Pulley rupture: Similar to the trigger finger examination, integrity of the pulley system can be evaluated promptly using US imaging. The annular pulleys are first recognized in their short axis view (along the long axis of the fingers) as tiny hypoechoic linear bands overlying the flexor tendons. The pulley system allows stabilization of the flexor tendons on the anterior phalangeal cortex. In cases of ruptures, either the pulley cannot be clearly/directly visualized or the characteristic/indirect finding of flexor tendon dislocation (away from the adjacent cortex) can be observed as 'bowstringing'. The patient can be asked to perform resisted flexion with his fingertip against the examiner to increase the diagnostic certainty whereby the tendons will normally remain adjacent to the underlying bony surface (**Video 32, <http://links.lww.com/PHM/B628>**). While maximal bowstringing over the proximal phalanx indicates an A2 pulley injury (**Video 33, <http://links.lww.com/PHM/B629>**); in A4 pulley injuries, the bowstringing is mostly pronounced at the middle phalanx level.⁴³

Volar plate injuries: Dynamic studies can be used to determine the amount of soft tissue edema and mobility of the volar plate (**Video 34, <http://links.lww.com/PHM/B630>**). The unstable volar plate can be visualized during hyperextension - with increased mobility.⁴⁴ Dynamic testing should particularly be performed in post-traumatic conditions. The most common pathological US findings are i) penetration of joint effusion within a focal gap of the volar plate (**Video 35, <http://links.lww.com/PHM/B631>**), ii) excessive excursion of the volar plate (chronic instability

due to a previous trauma), iii) aberrant movements of a small (bony) fragment in avulsions of the volar plate attachment on the base of the phalanx. Herewith, in some patients, a post-traumatic exuberant scar of the volar plate can lead to a mechanical conflict of the joint - easily depictable during dynamic imaging.

Proximal interphalangeal (PIP) and distal interphalangeal (DIP) joint instability: Dynamic imaging under stress (valgus for ulnar and varus for radial ligaments) or with sagittal plane instability induced by hyperextension forces may be useful for assessing interphalangeal joint integrity (**Video 36**, <http://links.lww.com/PHM/B632>). Collateral ligament injuries range from sprains and partial-thickness tears with no or minimal loss of articular stability to complete tears with significant joint instability.⁴⁵ Sagittal plane instabilities of the PIP and DIP joints can be associated with lesions of volar plates, collateral ligaments or even bone fractures. Accordingly, during the US examination, it should be kept in mind that acute trauma can be associated with collateral ligament sprain, partial tear or complete disruption. Various levels of valgus/varus instability can be determined using stress under dynamic scanning. Chronic instability of these joints are usually coupled with thickening of the collateral ligaments, fibrosis, formation of enthesophytes, or even avulsion fractures of the collateral ligaments.⁴⁶

Clenched fist - human bite injury: This injury is frequently associated with complete or partial tears of the extensor tendons. Sonographic characteristics comprise soft tissue hypoechogenicity, consistent with edema and tendon disruption. Dynamic imaging during MCP joint active or passive flexion/extension can be confirmatory in ambiguous cases - showing the extent of the lesion.

Boxer's knuckle: Dynamic US study in the axial plane, at the level of the distal metacarpal heads can demonstrate partial/complete instability of the digital extensor tendons during flexion of the extended MCP joint against resistance (**Video 37**, <http://links.lww.com/PHM/B633>). The type of tendon instability is related to the seriousness of the sagittal band injury (**Figure 3F**). The sagittal bands connect the extensor tendons to the collateral ligaments and the volar plates of the MCP joints. Subluxation may also be congenital (**Video 38**, <http://links.lww.com/PHM/B634>) or acquired (**Video 39**, <http://links.lww.com/PHM/B635>) due to degenerative/inflammatory changes of the sagittal band.

Insertional tendinous ruptures: During active/passive movements, the extensor/flexor tendon integrity can be assessed until its insertion at the base of the distal phalanx (**Videos 35 and 40**, <http://links.lww.com/PHM/B631>, <http://links.lww.com/PHM/B636>). From the dorsal aspect, the extensor tendon tear (**Video 41**, <http://links.lww.com/PHM/B637>) or the distal phalanx avulsion fracture (i.e. "Mallet finger") can be clearly exposed.⁴⁷ From the volar aspect, a partial or complete tear of the flexor digitorum superficialis/profundus tendon can be easily assessed during the dynamic ultrasound (**Video 42**, <http://links.lww.com/PHM/B638>). In addition, foreign bodies and their relationship with the tendons can be visualized as well (**Video 43**, <http://links.lww.com/PHM/B639>).⁴⁸

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Figure Legends

Figure 1

Schematic drawings and cadaveric specimens show the dynamic assessment of the radiocarpal synovial cavity (*light blue*) during flexion/extension of the wrist (**A, B, C**), of the TFCC located at the level of the ulnocarpal space during radial/ulnar deviation of the wrist (**D, E**), the distal radioulnar joint (*light blue*) during the squeeze maneuver (*red arrow*) of the distal forearm (**F**), and, of the dorsal scapholunate ligament (*yellow*) during stress movements (*red arrows*) of the wrist (**G**).

lun: lunate, sca: scaphoid, tri: triquetrum, RC: radiocarpal joint, white asterisk: distal radioulnar joint recess, blue arrows: flow of the synovial fluid, rad: radius, u: ulna, white arrows: articular diastasis

Figure 2

Cadaveric specimens show the anatomical location of the extensor carpi ulnaris tendon (*black arrowhead*) within the bony groove of the ulna (*white lines*) (**A**), the fibrous sheaths (*black asterisks*) of the extensor tendons with a dorsal component (*black arrowhead*) and intercanal septa (*white arrows*) (**B**) and the sites of proximal (**C**) and distal (**D**) intersection syndromes.

1st: first extensor compartment, 2nd: second extensor compartment, 3rd: third extensor compartment, LT: Lister's tubercle

Figure 3

Schematic drawings and cadaveric specimens show the dynamic evaluation of the extensor carpi ulnaris (*ECU*) tendon during pronation/supination (*double red arrow*) of the wrist/forearm (**A**), of the lateral gliding (*red arrows*) and torsional movements (*green arrow*) of the median nerve (*yellow*) within the carpal tunnel among the flexor tendons (*white*) (**B, C**), of the ulnar collateral ligament (*yellow*) of the thumb – beneath the adductor aponeurosis (*white*) - during the valgus stress test (**D**), of the gliding movements (*thick red arrows*) of flexor digitorum superficialis (*yellow*) and profundus (*white*) tendons within the synovial sheath (*light blue*) and beneath the A1 pulley (*green*) during flexion/extension (*thin red arrows*) of the finger (**E**), and, of the extensor tendons (*black dotted lines*) of the finger while closing the hand into a fist (**F**).

sca: scaphoid, lun: lunate, tri: triquetrum, p: pisiform, light green: transverse carpal ligament, MC: metacarpal bone, PP: proximal phalanx, white arrows: articular diastasis, black arrows: shifting movements of the extensor tendons

Video Legends

Video 1

Normally, only a small amount or no effusion/synovial hypertrophy is apparent in the radiocarpal joint during the wrist flexion/extension. To understand what is normal for the individual patient, comparison with contralateral side is necessary in most cases.

Video 2

Radiocarpal joint effusion. While the wrist is dorsal flexed, thus radiocarpal joint recess is compressed, even a mild effusion can be elucidated.

Video 3

Dynamic assessment of a normal TFCC during active radioulnar deviations of the wrist.

Video 4

Dynamic assessment clearly shows mild effusion penetrating within a fissuration of the fibrocartilage disk of the TFCC.

Video 5

Ultrasound-guided stress test promptly shows synovial fluid penetrating inside a focal gap of the meniscus homologue of the TFCC.

Video 6

Dynamic assessment of a stable distal radioulnar joint during radial/ulnar deviation of the wrist and squeezing at the mid-forearm level.

Video 7

Dynamic assessment of a mild unstable distal radioulnar joint during radial/ulnar deviation of the wrist. Of note, a mild dynamic diastasis of the joint cleft, with an intra-articular vacuum effect (gas bubbles), can be observed during the dynamic ultrasound.

Video 8

Dynamic assessment - traction and flexion (stress test) - of the carpometacarpal joint of the thumb using a dorsal approach to evaluate an eventual instability in post-traumatic patients.

Video 9

Dynamic assessment - traction and extension (stress test) - of the carpometacarpal joint of the thumb using a volar approach to evaluate instability in post-traumatic patients (sonographic “grind test” of the thumb).

Video 10

During active radial/ulnar deviation of the wrist a snapping of a small cyst between the dorsal scapholunate ligament and the dorsal intercarpal ligament can be clearly observed.

Video 11

Proximal to distal (and vice-versa) sonotracking clearly shows the 3rd extensor compartment crossing over the 2nd one - the anatomical site for the distal intersection syndrome.

Video 12

Dynamic assessment of the extensor tendons (4th compartment) in long-axis view. No snapping of the tendons (smooth gliding) beneath a retinaculum.

Video 13

Wrist extensor retinaculum impingement. The dynamic evaluation of the extensor digitorum communis tendons demonstrates a mechanical conflict/impingement between the tendon and the extensor retinaculum of the wrist.

Video 14

Normally, during the active forearm supination/pronation, the extensor carpi ulnaris tendon remains stable in the ulnar groove.

Video 15

Extensor carpi ulnaris tendon instability. In patients with the extensor carpi ulnaris tendon instability, during supination/pronation, the examiner can observe the tendon dislocating out from the ulnar groove in the ulnar-volar direction.

Video 16

First wrist extensor compartment. Note the septum forming subcompartmentalisation.

Video 17

Dorsal wrist ganglion. While a pressure is applied by the probe, the ganglion cyst shows a partial compressibility.

Video 18

Dynamic assessment during active flexion/extension of the fingers clearly shows an accessory muscle (extensor digitorum brevis manus) over the dorsal surface of the hand.

Video 19

Axial view of the normal median nerve. While patient fully flexes the fingers by slowly making a fist, the examiner can observe the nerve lateral gliding and axial twisting with the surrounding flexor tendons.

Video 20

Axial view scanning demonstrates an accessory muscle, potentially compressing the median nerve.

Video 21

Dynamic assessment of the lumbrical muscles during active flexion of the fingers.

Video 22

Dynamic assessment of the flexor digitorum profundus tendon can be performed by blocking the middle phalanx and asking the patient to actively flex the distal interphalangeal joint.

Video 23

Dynamic assessment of the flexor digitorum superficialis tendon can be performed by blocking the proximal phalanx and asking the patient to actively flex the proximal interphalangeal joint.

Video 24

In a patient with Dupuytren's disease, flexor tendons are normally gliding beneath the annular pulleys despite the presence of a hypoechoic nodule superficially.

Video 25

Dynamic assessment (valgus stress test) of the ulnar collateral ligament of the thumb.

Video 26

Dynamic assessment shows diastasis of the ulnar side of the 1st metacarpophalangeal joint and the intra-articular effusion penetrating within the focal delamination of the ulnar collateral ligament of the thumb.

Video 27

Dynamic assessment of the flexor tendons of the finger at the level of the metacarpophalangeal joint during active flexion/extension. Note that the A1 pulley is clearly visible - superficial to the tendons - as an hypoechoic flat structure.

Video 28

Dynamic assessment of the flexor tendons of the finger in short-axis view.

Video 29

Dynamic scanning demonstrates a triggering beneath the A1 flexor pulley.

Video 30

Trigger finger due to impingement with A3 annular pulley. Note the superficial flexor tendon being compressed during flexion.

Video 31

Trigger finger due to A5 annular pulley hypertrophy.

Video 32

Normally, the flexor tendon remains adjacent to the bony surface during resisted finger flexion.

Video 33

A2 pulley rupture causes “bowstringing” of the flexor tendon during resisted finger flexion. Note the flexor tendon being pulled away from the bony surface.

Video 34

Dynamic assessment of the volar plate during passive hyper-extension of the distal interphalangeal joint of the finger. Using the same dynamic maneuver, the insertional site of the flexor digitorum profundus tendon at the level of the base of the distal phalanx can also be evaluated.

Video 35

During the dynamic assessment of the volar compartment of the metacarpophalangeal joint, a small amount of synovial fluid - which penetrates within a focal gap of the base of the volar plate - can be observed.

Video 36

Dynamic assessment (varus/valgus stress) of the radial or ulnar collateral ligament of the proximal/distal interphalangeal joint of the finger.

Video 37

Dynamic stabilization of the extensor tendon of the finger - at the level of the metacarpal head - by the fibrous hood originating from the lumbrical/interosseous muscles.

Video 38

Congenital instability of the digital extensor tendons. Voluntary/habitual dislocation of the digital extensor tendons during the fist position.

Video 39

Dynamic ultrasound imaging shows instability of the digital extensor tendons as the subject makes a fist.

Video 40

Dynamic scan of the insertion zone of the extensor tendon of the finger at the base of the distal phalanx.

Video 41

Dynamic maneuver shows the partial tear of the central slip of the extensor tendon of the finger.

Video 42

Dynamic assessment shows a focal injury selectively involving the deep fibers of the flexor digitorum profundus tendon at the level of the pre-insertional segment.

Video 43

Dynamic imaging of the extensor tendon foreign body.

Figure 1

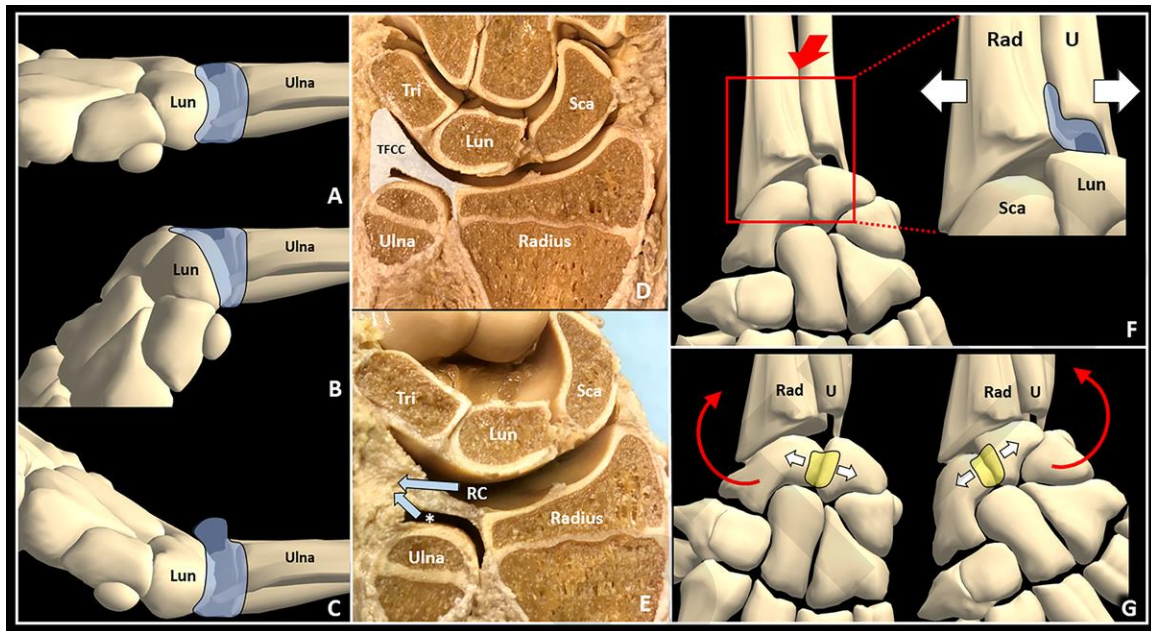


Figure 2

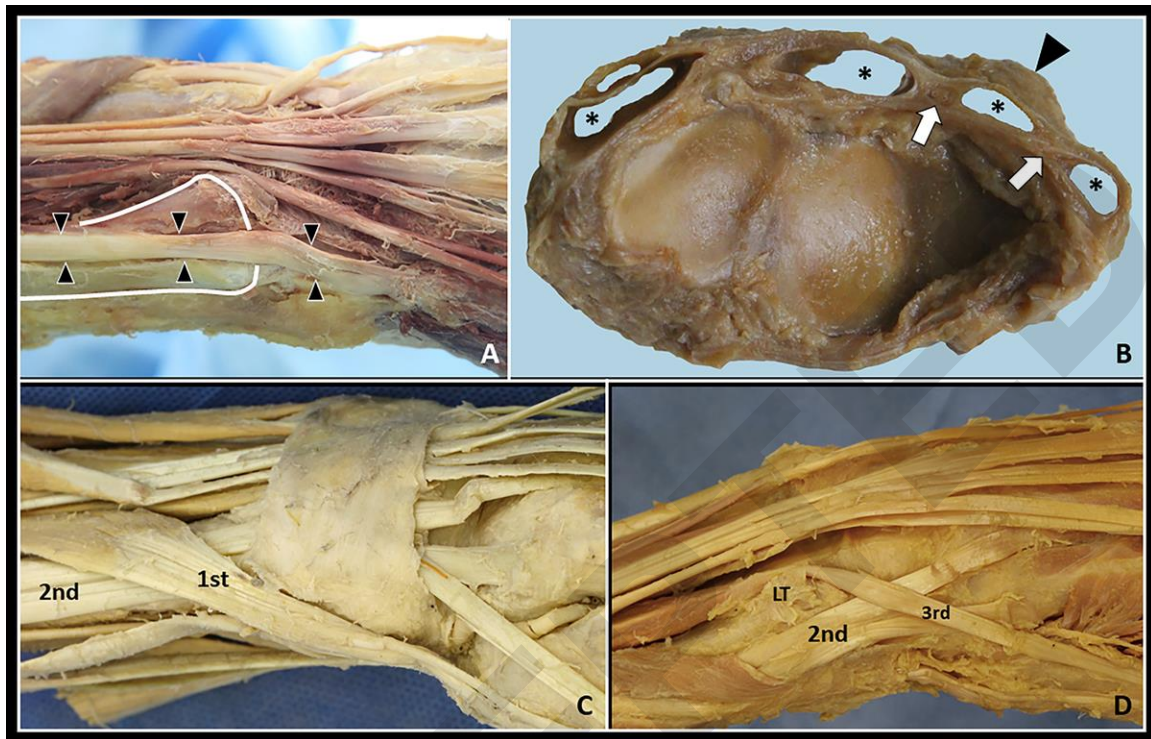


Figure 3

