

Carpal Tunnel Syndrome and Sonography of the Wrist

Indications

- Carpal tunnel syndrome
- Ganglion and synovial cysts
- Tears of the triangular fibrocartilage
- Tenosynovitis
- Tumors

Carpal Tunnel Syndrome (CTS)

The carpal tunnel is the fibro-osseous space between the carpal bones and the flexor retinaculum. It contains the eight flexor digitorum tendons, the flexor pollicis longus, the median nerve, and occasionally a persistent median artery.

Signs and Symptoms

- Paresthesia in the distribution of the median nerve
- Nocturnal paresthesia in the fingers
- Thenar atrophy
- Positive Tinel's sign: a sensation of tingling, or pins and needles, in the distal extremities of a limb when percussion is made over the site of an injured nerve
- Phalen's sign: reproduction of pain or paresthesia with flexion of the wrist for one minute or more

The etiology of carpal tunnel syndrome is primarily the encroachment on the median nerve. This can be due to either a decrease in size of the tunnel (mainly osseous causes), or increase in the volume within the confined space of the tunnel. The most recently described common cause of CTS is repetitive stress injury, as in computer keyboard operators.

Osseous causes of tunnel narrowing

- Malalignment of carpal bones
- Displaced fractures
- Callus formation
- Hypertrophic bone changes

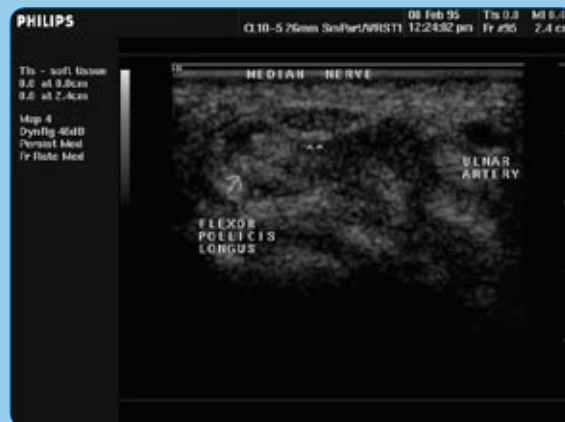


Image 1: Normal wrist.

Increased volume causes of tunnel narrowing

- Tendon sheath enlargement (traumatic synovitis)
- Synovial proliferation (rheumatoid arthritis)
- Hypertrophied muscles (occupational)
- Increased fat (obesity)

Patient positioning

The forearm should rest comfortably on a flat surface, with the elbow in midflexion and the wrist in supination.

Anatomic landmarks and imaging technique

In the transverse imaging plane, the ulnar artery is the medial landmark of the carpal tunnel. Imaging must be performed with the transducer in a plane perpendicular to the tendon surface to eliminate the anisotropic effect. The tunnel contains the flexor digitorum tendons which are hyperechoic. Anterior to the tendons is the median nerve. The median nerve has a characteristic appearance which differentiates it from the fibrillar hyperechoic tendons. The nerve is hypoechoic with a hyperechoic border and shows multiple bright reflectors in the transverse imaging plane. The median nerve is rounded or oval in the proximal wrist and flattens progressively as it courses through the carpal tunnel. Within the tunnel the nerve is in intimate contact with the flexor retinaculum; its size remains constant but its shape is quite variable.

In the longitudinal imaging plane the nerve is demonstrated coursing parallel and superficial to the flexor digitorum tendons. The sonographic appearance of the nerve in this plane demonstrates hyperechoic continuous anterior and posterior borders (the nerve sheath) and is easily distinguished from the characteristic fibrillar appearing tendons that lie posteriorly.

Sonographic Findings in Carpal Tunnel Syndrome

Subjective criteria

- Flattening of the nerve, especially at the level of the hamate bone (see Image 2)
- Volar bulging of the flexor retinaculum (see Image 3)
- Enlargement of the median nerve as it enters the carpal tunnel (see Image 4)
- Large fluid or fat layer surrounding the tendons
- Decreased mobility of the median nerve on flexion and extension of the fingers, hand or wrist

Objective criteria

- The mean cross sectional area of the median nerve is greater than 10 mm squared at the pisiform bone level (see Image 4)
- The flattening ratio of the nerve (transverse diameter divided by AP diameter) is greater than 4:1 at the level of the hamate bone (see Image 4)
- Volar bulging of the flexor retinaculum is greater than 3.1 mm (see Illustration A)

Triangular Fibrocartilage

The triangular fibrocartilage (TFC) lies between the ulnar styloid, triquetrum and lunate, and distal radius, deep to the pronator quadratus muscle. The TFC maintains the stability of the distal radioulnar and ulnocarpal joints. Disruption and degeneration of the TFC are common causes of ulnar and wrist pain. To image the TFC, the examiner places their index finger on the tip of the ulnar styloid process. The transducer is positioned immediately proximal to the examiner's finger. The cartilage of the ulnar head is seen as a hypoechoic band, and the hyperechoic TFC is visualized as the transducer is moved distally. (see Illustrations B and C)

Conditions Diagnosed in the Hand

- Tendon rupture
- Ganglion cysts – well defined hypoechoic regions
- Synovial cysts – lobulated, fluid-filled lesions arising from tendons or joints

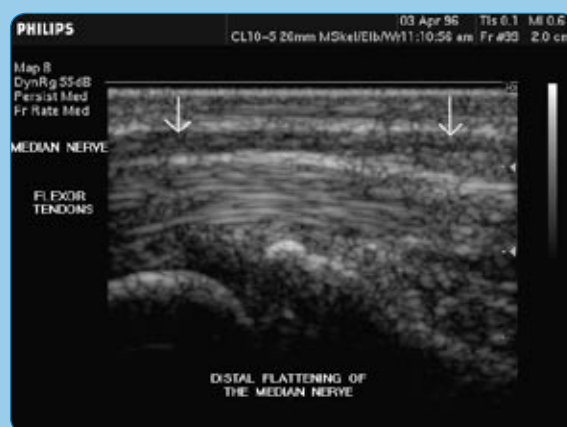


Image 2: Flattening of the median nerve.



Image 3: Volar bulging of the flexor retinaculum.



Image 4: Enlargement and flattening of median nerve.

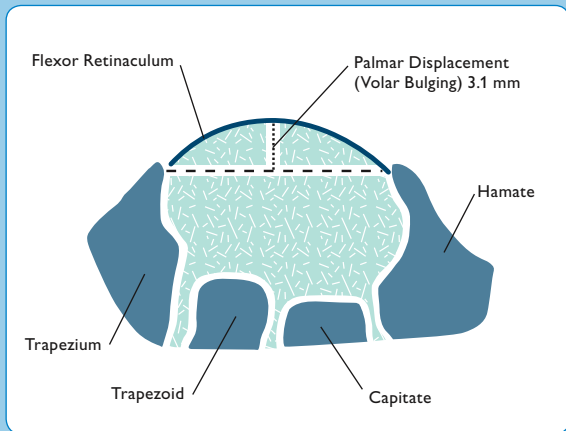


Illustration A: Flattening of the median nerve.

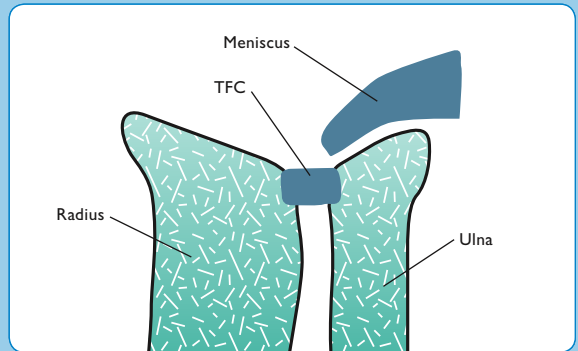


Illustration B: Diagram of triangular fibrocartilage.

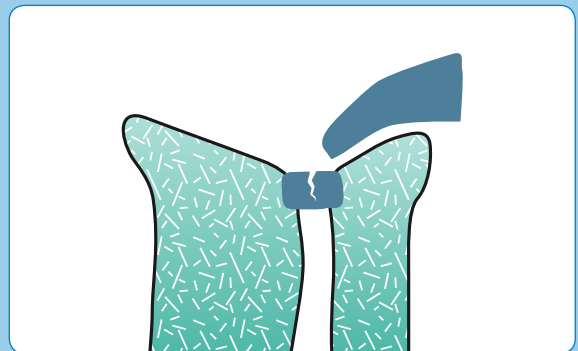


Illustration C: Diagram of torn triangular fibrocartilage.

CLINICAL SOURCE

Nabil Maklad, MD, PhD
Houston, Texas

Phebe Chen, MD
Houston, Texas

Patty Jackson, RDMS
Philips Ultrasound, Bothell, WA

REFERENCES

Buchberger W, Schon G, Strasser K, et al. High-resolution ultrasonography of the carpal tunnel. *J Ultrasound Med* 10: 531-537, 1991.

Buchberger W, Judmaier W, Birbamer G, et al. Carpal tunnel syndrome: diagnosis with high-resolution sonography. *Amer J Roentgen* 159: 793-798, 1992.

Dalinka M. MR Imaging of the wrist. *Amer J Roentgen* 164: 1-9, 1995.

Fornage BD, Schernberg FL, Rifkin MD. Ultrasound examination of the hand. *Radiology* 155: 785-789, 1985.

Mesgazadeh M, Schneck CD, Bonakdarpour A, et al. Carpal Tunnel MR imaging. Part II. Carpal tunnel syndrome. *Radiology* 171: 749-745, 1989.

Sugimoto H, Miyaji N, Ohsawa T. Carpal tunnel syndrome: evaluation of median nerve circulation with dynamic contrast-enhanced MR imaging.

Hoglund M, Tordai P, Engkvist O. Ultrasonography for the diagnosis of soft tissue conditions in the hand. *Scand J Plast Reconstr Surg Hand Surg* 25: 225-231, 1991.



**Philips Medical
Systems is part
of Royal Philips
Electronics**

[www.medical.philips.com/
ultrasound](http://www.medical.philips.com/ultrasound)

North America
Tel: 800 229 6417
Asia Pacific
Tel: 852 2821 5888
Europe
Tel: 49 40 5078 4532
Latin America
Tel: 954 835 2600

© Koninklijke Philips
Electronics N.V. 2003.
All rights are reserved.
Reproduction in whole or in
part is prohibited without
prior written consent of the
copyright holder.

Philips Medical Systems
Nederland B.V. reserves
the right to make changes
in specifications or to
discontinue any product, at
any time without prior notice
or obligation, and will not be
liable for any consequences
resulting from the use of this
publication.

Printed in USA G64216 6-03

