

Ultrasound of Nerve Entrapments in Osteofibrous Tunnels of the Upper and Lower Limbs

Essay

Submitted for Partial Fulfillment of Master Degree in Radiodiagnosis

By

Shimaa Hamdy Mohamed Khalil

M.B.B.CH

Cairo University

Supervised By

Dr. Manar Hussein Abd El Sattar

Assistant Professor of Radiodiagnosis

Faculty of Medicine

Cairo University

Dr. Ahmed Mohamed Wafaie

Assistant Professor of Radiodiagnosis

Faculty of Medicine

Cairo University

Cairo University

2009

Dedication

*To my husband, my parents, my sisters and
my friends, with love
for their never ending-support*

Shimaa

Abstract

The development of high resolution ultrasound has allowed evaluation of normal and abnormal ultrasound appearance of peripheral nerves. Ultrasound provides a unique method for evaluation of these nerves because it allows direct imaging of nerves, as well as changes in nerve shape and echo texture. Ultrasound has an ability to follow nerves over a long distance in a limb. The colour and power Doppler improve the ability to evaluate the peripheral nerves by evaluation of near vessels. Entrapment neuropathies are group of disorders result from injury to a nerve as it travels through osteofibrous tunnels.

Key words:-

Ultrasound - Peripheral nerves - Entrapment neuropathies - Osteofibrous tunnels - Upper limb - Lower limb.

Acknowledgment

First and foremost, thanks to Allah

In all gratitude, I would like to express my great appreciation and sincere thanks to Dr. Manar Hussein Abd El Satar, Assistant Professor of Radiodiagnosis, Faculty of Medicine, Cairo University, for her wise guidance and precious advices & Dr. Ahmed Mohamed Wafaie, Assistant Professor of Radiodiagnosis, Faculty of Medicine, Cairo University, for his keen supervision and continuous support. Working under their supervision has been a great honor to me.

I also feel deeply thankful to everyone that helped, encouraged, and participated willingly and kindly to get this work to come to existence. Thanks to my wonderful family for their love and belief in me.

Shimaa

List of Contents

	Page
Introduction & aim of work	- 1
Review of literature	-
- Ultrasound of nerve entrapments in osteofibrous tunnels of the upper limbs	
Gross anatomy of nerves and osteofibrous tunnels in upper limbs	- 4
Ultrasound technique	- 15
Normal ultrasound appearance of nerves	- 16
Tecqnique and sonoanatomy of median nerve	- 22
Tecqnique and sonoanatomy of ulnar nerve	- 26
Nerve entrapment syndromes in upper limbs	- 30
Carpal tunnel syndrome	- 30
Cubital tunnel syndrome	- 41
Guyon tunnel syndrome	- 49
Ultrasound of nerve entrapments in osteofibrous tunnels of the lower limbs	-
Common peroneal nerve entrapment	- 52
Tarsal tunnel syndrome	- 57
Inter digital nerve entrapment at inter metatarsal spaces	- 63
Summary	- 67
References	- 70
Arabic Summary	-

List Of Figures

		Page
Figure (1)	Cross section of wrist showing the anatomy of the carpal tunnel.	5
Figure (2)	Passage of ulnar nerve through the cubital tunnel.	6
Figure (3)	Anatomy of guyon tunnel.	7
Figure (4)	Median nerve as it passes between two heads of pronator teres.	8
Figure (5)	Muscular branches of median nerve.	9
Figure (6)	Sensory innervation of median nerve.	10
Figure (7)	Cross section through the middle of upper arm.	11
Figure (8)	Cross section through distal forearm.	12
Figure (9)	Cross section through wrist and digits.	13
Figure(10)	Branches of ulnar nerve.	14
Figure(11)	Normal ultrasound of a peripheral nerve.	17
Figure(12)	Bifid median nerve and median artery	19
Figure(13)	Entrapment neuropathy.	21
Figure(14)	Transverse US image through the mid-upper arm showing the neurovascular bundle.	22
Figure(15)	Photographs show the surface anatomy of the median and ulnar nerves.	23
Figure(16)	US scan longitudinal view of the digital nerve.	24

Figure(17)	Longitudinal US view of the median nerve (arrows) as it plunges down between the superficial (SP) and deep heads of the pronator teres (DP) muscle at the elbow.	25
Figure(18)	Longitudinal US image of the course of the median nerve between the flexor superficialis(FS) and the flexor profundus(FP).	26
Figure(19)	Anatomic dissection showing the very close association of the ulnar nerve, medial epicondyle and nearby olecranon.	27
Figure(20)	Longitudinal US images of the course of the ulnar nerve around the forearm beneath the flexor carpi ulnaris.	28
Figure(21)	Transverse (upper) and longitudinal (lower) US views of the relation of the ulnar nerve to the pisiform as it enters Guyon canal.	29
Figure(22)	Picture showing moderate thenar atrophy of the left hand in a woman with bilateral carpal tunnel syndrome.	31
Figure(23)	(US scan) (a, b, c, d) Carpal tunnel syndrome in a 65-year-old woman with an aberrant flexor muscle of the index finger.	33-34
Figure(24)	(US scan) (a, b) Carpal tunnel syndrome in a 37-year-old man with a persistent median artery of the forearm.	35
Figure(25)	(US scan) (a, b) Carpal tunnel syndrome in a 52-year-old man with rheumatoid arthritis.	36

Figure(26)	(US scan) (a, b) Carpal tunnel syndrome in a 40-year-old woman with a large intramuscular hemangioma.	37
Figure(27)	(US scan) (a, b) Carpal tunnel syndrome in a 48-year-old woman with multiple myeloma and deposits of amyloid in the deep carpal tunnel.	38
Figure(28)	(US scan) (a, b) Carpal tunnel syndrome: ganglion.	39
Figure(29)	(US scan) Carpal tunnel syndrome in a 43-year-old man with perilunate dorsal dislocation of the wrist.	40
Figure(30)	Ulnar Nerve at elbow joint	41
Figure(31)	Area of pain and numbness in cubital tunnel syndrome.	43
Figure(32)	(US scan) Cubital tunnel syndrome in a 65-year-old man with a history of trauma to the elbow and heterotopic ossification in the cubital tunnel area.	45
Figure(33)	(US scan) (a, b, c) Cubital tunnel syndrome in a 47-year-old woman with posttraumatic changes in the elbow resulting in cubitus valgus.	45-46
Figure(34)	(US scan) Cubital tunnel syndrome: ganglion.	47
Figure(35)	(US scan) Ulnar nerve compressed by hemangioma.	48
Figure(36)	(US scan) Ulnar nerve compressed by tumor.	48
Figure(37)	The path of the ulnar nerve as it passes through the base of the hand in its tunnel called Guyon's Canal.	49
Figure(38)	(US scan) Guyon tunnel syndrome in a 54-year-old man with a pisotriquetrum ganglion.	51
Figure(39)	(a, b, c) Common peroneal nerve at the fibular neck. (b, c) are US scan.	53-54

Figure(40)	(US scan) Common peroneal nerve entrapment by a ganglion in a 54-year-old man.	56
Figure(41)	(a, b, c)Tarsal tunnel anatomy. (b, c) are US scan.	57-58
Figure(42)	(US scan) Tarsal tunnel syndrome in a 61-year-old woman with a tibiotalar ganglion.	60
Figure(43)	(US scan) Tarsal tunnel syndrome: ganglion.	61
Figure(44)	(US scan) (a, b) Tarsal tunnel syndrome in a 32-year-old man with posttraumatic bone changes at the posteromedial ankle.	62
Figure(45)	(a, b, c) Morton neuroma.	65-66

INTRODUCTION AND AIM OF WORK

The brain and spinal cord receive and send information through muscles and nerves. The nerves travel to upper and lower limbs and traverse the various joints along their paths. Unfortunately, these nerves can become compressed or entrapped at various regions of the extremities (Ly-Pen et al, 2005).

Osteofibrous tunnels are narrow anatomic passageways that redirect the course of nerves along with tendons and vessels across synovial joints (Sailer, 1996).

Many nerves pass in osteofibrous tunnels in upper and lower limbs.

In upper limbs median nerve passes through carpal tunnel, ulnar nerve passes through cubital tunnel at elbow and guyon tunnel at wrist. In lower limbs common peroneal nerve passes around the fibular neck, tarsal nerve passes in retromalleolar region, interdigital nerves pass in intermetatarsals region (Spratt et al, 2002).

Entrapment neuropathies are a group of disorders result from chronic injury to a nerve as it travels through osteofibrous tunnels and characterized by pain and/or loss of function (Szabo, 1999).

The diagnosis of nerve entrapment at osteofibrous tunnels relies primarily on clinical and electrodiagnostic findings (Sailer, 1996).

Recently, the refinement of high frequency broadband transducers with arrange of 5-15 MHz, and sensitive color and power Doppler technology have improved the ability to evaluate peripheral nerve entrapment in osteofibrous tunnels with Ultrasonography (Stuart et al, 2004).

High-resolution Ultrasound provides a unique method for evaluating peripheral nerves because it allows direct imaging of the involved nerves, as well as documentation of changes in nerve shape and echotexture that occur in compressive syndromes, as well as its ability to follow structures over long distances in a limb, and its dynamic nature that allows movement of patient and transducer (Martinoli et al, 2000).

The ultrasound appearance closely correlates to the histologic findings both in transverse and longitudinal images (Silvistri et al, 1995). Normal nerves appear as markedly echogenic tubular structures (corresponding to the supportive connective tissue) containing hypoanechoic discontinuous segments that correspond to the fascicles or group of fascicles. On transverse scans peripheral nerves appear as hyperechoic structures including oval-to-round hypoechoic areas. The size of a single nerve decreases when examined from proximal to distal due to the presence of branches leaving the main nerve trunk. Usually no normal internal blood flow can be detected with color Doppler and as a general rule detectable internal flow signals must be considered as pathologic hypervascular changes (Lowey, 2001).

At most centers, Magnetic Resonance Imaging continues to be the standard for evaluation of the peripheral nervous system because image acquisition is not operator dependent, as it is in Ultrasonography, and interpretation is intuitively easier (Walker et al, 2004).

However Ultrasonography has many advantages over Magnetic Resonance Imaging, including being relatively fast and inexpensive and allowing additional dynamic and blood flow imaging with relatively little additional time and can explore long segments of nerve trunks in a single study (Walker et al, 2004).

AIM OF WORK

The purpose of this study is to describe the features on high-frequency ultrasound of nerve entrapments in osteofibrous tunnels of the upper and lower limbs.

Gross anatomy of nerves and osteofibrous tunnels in upper limbs

Anatomy of osteofibrous tunnels in upper limbs:

1-Anatomy of carpal tunnel: (fig.1)

The floor and walls of the carpal tunnel are formed by the the carpus which is composed of the carpal bones and has a concave bony contour on its flexor surface and is covered by the flexor retinaculum. The rigid flexor retinaculum forms the roof of the tunnel. The flexor retinaculum, or transverse carpal ligament, attaches to the scaphoid tubercle, the ridge of the trapezium, and the ulnar aspect of the hook of the hamate and pisiform (Palmar et al, 2007).

The proximal fibers of the volar carpal ligament contribute to the roof of the carpal tunnel but this contribution is not as significant as that of the thicker flexor retinaculum. The long flexors of the fingers and thumb (flexor pollicis longus, flexor digitorum superficialis, flexor digitorum profundus) all pass through the carpal tunnel. The separate flexor digitorum superficialis tendons are arranged in two rows, with the tendons to the third and fourth digits positioned volar to the tendons of the second and fifth digits. The flexor digitorum profundus tendons are arranged in the same coronal plane and the tendon to the second digit is separated from the 3 adjacent profundus tendons.

All 8 flexor tendons are covered with a common synovial sheath. The flexor pollicis longus tendon, contained in its own synovial sheath, is located on the radial aspect of the flexor tendons within the carpal tunnel.

The median artery and nerve are included inside the tunnel (Colak et al, 2007).

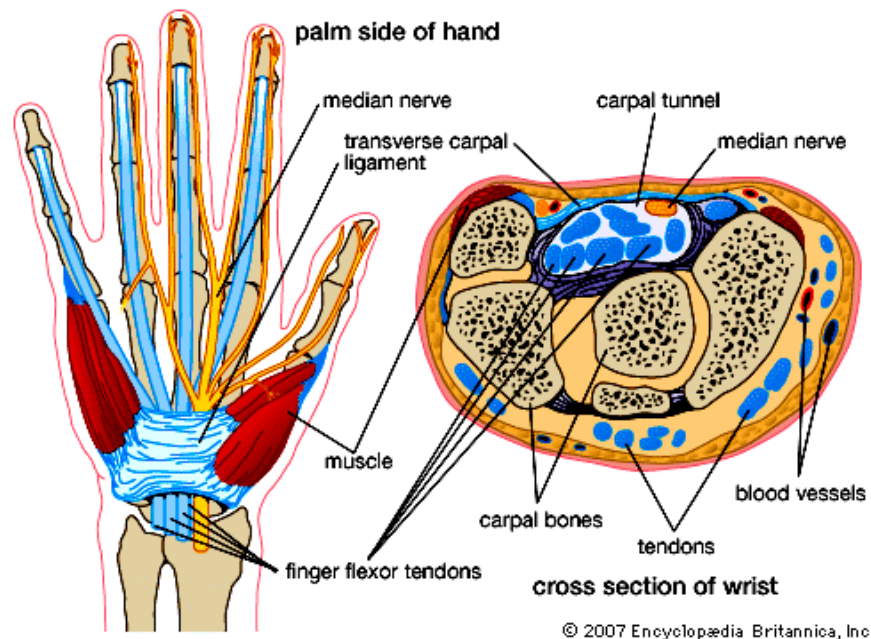


Fig.1: Cross section of wrist showing the anatomy of the carpal tunnel. (Colak et al, 2007).

2-Anatomy of cubital tunnel: (fig.2)

The cubital tunnel is formed by a groove between the olecranon process of the ulna and the medial epicondyle of the humerus and bridged by a fascial sheet, the cubital tunnel retinaculum (also known as Osborne fascia).

During elbow flexion and extension, the cubital tunnel changes its shape (from slightly ovoid to elliptical) and volume because of the eccentric origin of the retinaculum (Gelberman et al, 1998).

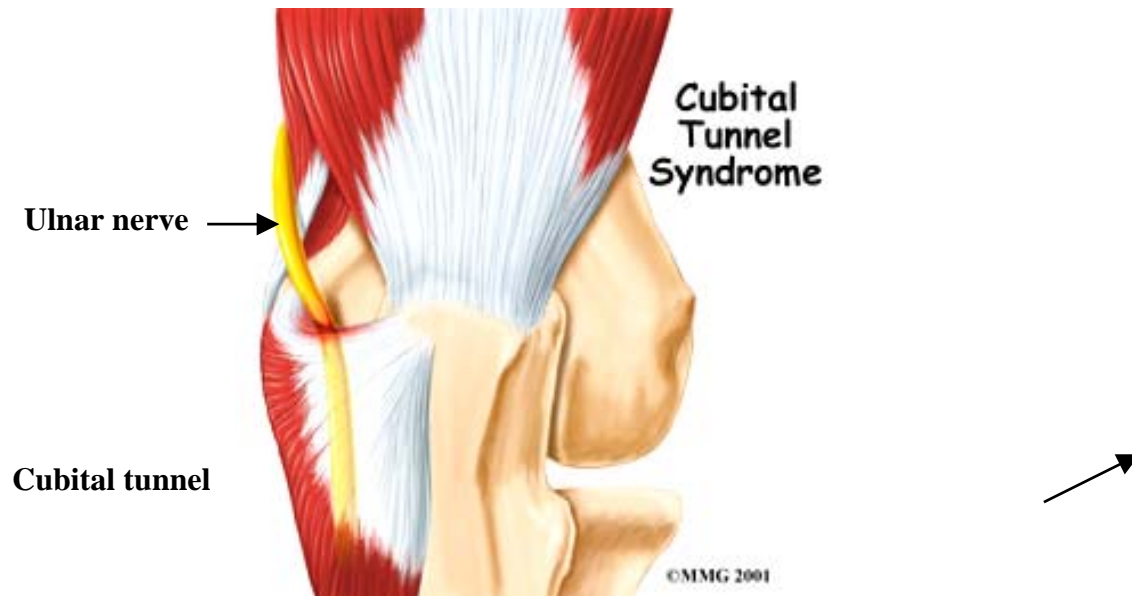


Fig.2: Showing passage of ulnar nerve through the cubital tunnel (Pascarelli et al, 2001).

3- Anatomy of guyon tunnel: (fig.3)

The walls of this canal consist of the pisiform medially and the hook of the hamate laterally; the floor is formed by the flexor retinaculum, and the roof is formed by the palmar carpal ligament and the palmaris brevis muscle.

The guyon tunnel houses the ulnar nerve, ulnar artery, and the ulnar vein (Stewart, 1993).