

Sunderlands Fascicles: High Frequency Ultrasonic Confirmation of Median Motor Neuropathy with



Sparing of Sensory Axons

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CASE DESCRIPTION

Herein we present the case of a 46-year-old RHD man referred for electrodiagnostic (EDx) study after bilateral self-inflicted forearm lacerations, with subsequent right flexor pollicis longus (FPL) repair and right median nerve grafting, 3 months prior to presentation. He was treated in the post-operative period with gabapentin and occupational therapy, but reported persistent bilateral hand weakness, left hand sensory deficits affecting the thumb/thenar eminence and right hand sensory deficits affecting the entire median nerve distribution. Nerve conduction studies (NCS) demonstrated severe right median sensorimotor neuropathy proximal to the wrist with axon loss, and severe left median motor neuropathy proximal to the wrist with preservation of sensory axons (table 1). Bilateral wrist/hand ultrasound (US) using 15MHz probe demonstrated a left focal hypoechoic region transecting the radial aspect of the median nerve with >50% CSA involvement (figure 1). Right median nerve demonstrated focal enlargement and fascicular derangement 2cm proximal to the wrist crease. He was referred to orthopaedic surgery and subsequently underwent right median nerve allograft, extensor indicis proprius opponensplasty and FPL repair debridement.

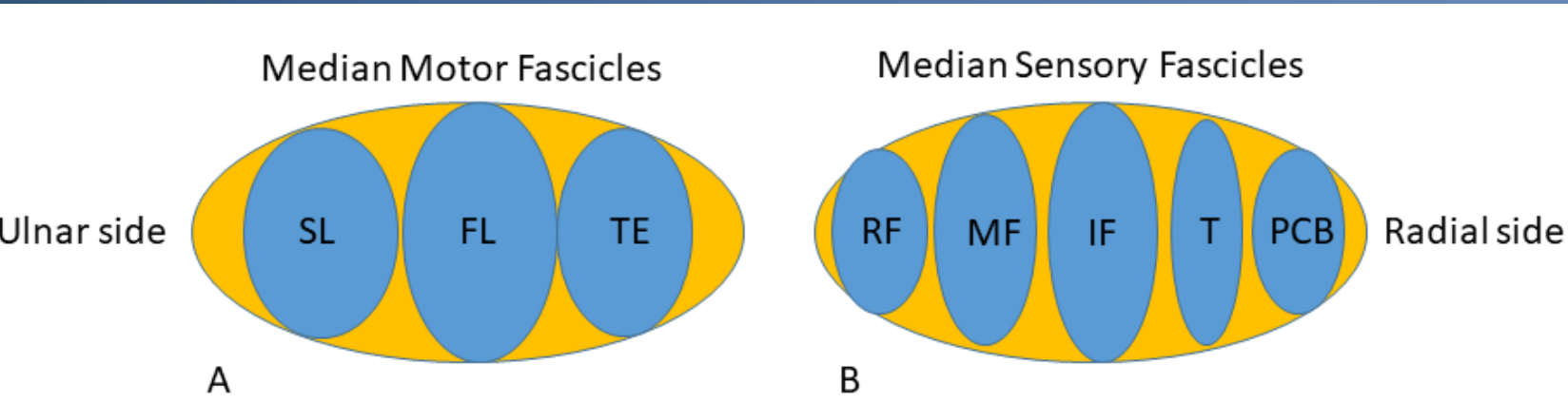


Figure 2. Graphic representation of intraneural topography of the median nerve at the wrist (adapted from Zanette et al). The fascicles are represented from ulnar to radial side, from reader's left to right. A) Median motor fascicles. B) Median sensory fascicles. SL, second lumbrical. FL, first lumbrical. TE, thenar eminence. RF, ring finger. MF, middle finger. IF, index finger. T, thumb. PCB, palmar cutaneous branch.

TABLE 1

	ms	mV		mm	ms	m/s
Median.R to Abductor pollicis brevis.R						
Wrist	NR	NR	Abductor pollicis brevis-Wrist	80		
Elbow	NR	NR	Wrist-Elbow			
MN to PT	2.6	11.4	Elbow-MN to PT			
Ulnar.R to Abductor digiti minimi (manus).R						
Wrist	2.6	12.4	Abductor digiti minimi (manus)-Wrist	80	2.6	
Below elbow	6.1	12.5	Wrist-Below elbow	230	3.5	66
Above elbow	7.7	12.7	Below elbow-Above elbow	85	1.6	53
Median.L to Abductor pollicis brevis.L						
Wrist	NR	NR	Abductor pollicis brevis-Wrist	80		
Elbow	NR	NR	Wrist-Elbow			
MN to PT	2.5	13.0	Elbow-MN to PT			
Ulnar.L to Abductor digiti minimi (manus).L						
Wrist	2.7	11.4	Abductor digiti minimi (manus)-Wrist	80	2.7	
Below elbow	6.6	10.7	Wrist-Below elbow	215	3.9	55
Above elbow	8.4	10.8	Below elbow-Above elbow	95	1.8	53

Sensory Nerve Conduction:

Nerve and Site	Peak Lat ms	Amp (Baseline-to-Peak) μ V	Segment	Dist mm
Median.R to Digit II (index finger).R				
Wrist	NR	NR	Digit II (index finger)-Wrist	140
Ulnar.R to Digit V (little finger).R				
Wrist	2.8	17	Digit V (little finger)-Wrist	140
Median.L to Digit II (index finger).L				
Wrist	3.3	16	Digit II (index finger)-Wrist	140
Ulnar.L to Digit V (little finger).L				
Wrist	2.9	20	Digit V (little finger)-Wrist	140

Table 1. NCS of bilateral median and ulnar nerves demonstrating severe right sensorimotor median neuropathy and severe left median motor neuropathy proximal to the wrist.

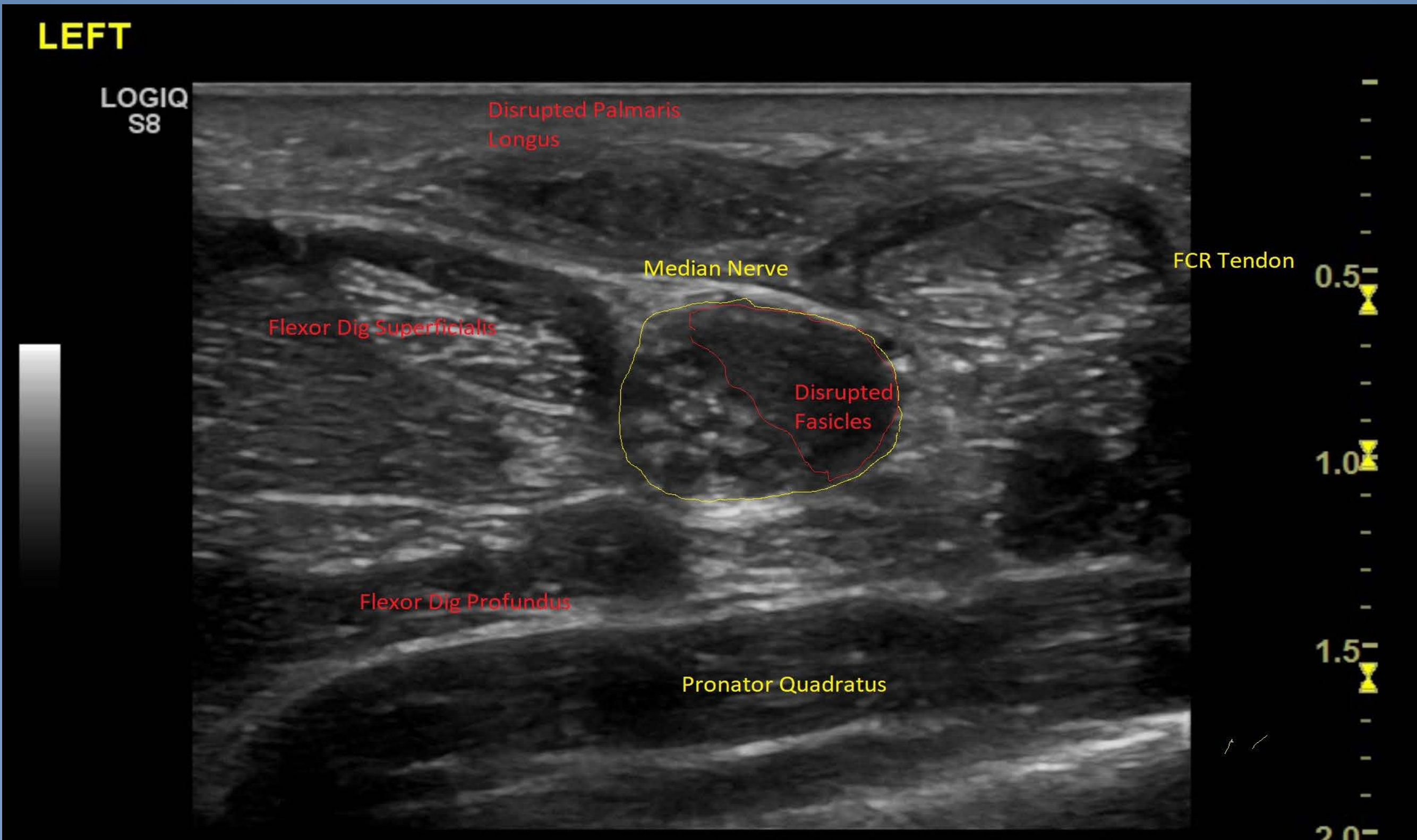


Figure 1. US left median nerve. Muscles are labeled for localization. The median nerve is circled in yellow. The disrupted radial-sided fascicles are circled in red.

DISCUSSION

In 1945 Sunderland first described the intraneural topography of the median nerve via microdissection stating there was no consistent fascicular patterns.¹ However, more recent autopsy studies suggest a radial to ulnar fascicular arrangement of the median nerve at the wrist with the radial fascicles innervating the thenar eminence (figure 2).^{2,3} A study in 2016 utilized electromyography and ultrasound studies concomitantly in order to further characterize the fascicular arrangement of the median nerve in two cases of traumatic median neuropathy at the wrist. Their findings supported the radial to ulnar fascicular arrangement shown in the more recent cadaveric studies.⁴ Our patient's EDx study demonstrated left median motor neuropathy, with sparing of sensory fascicles, in the setting of ultrasound demonstrated disruption of the radial-sided fascicles of the median nerve at the wrist (table 1, figure 1). Taken together, these data lend further support to the growing body of literature on intraneural topography of the median nerve at the wrist.

LEARNING POINTS

- Our case supports the growing case for intraneural topography of the median nerve at the wrist
- Joint evaluation with both EMG and high frequency ultrasound is of value
- Future studies with ultrahigh frequency ultrasound are warranted to further characterize the organization of the median nerve which may help in operative planning as well as the development of prosthetic interfaces.

REFERENCES

1. Sunderland S. The intraneural topography of the radial, median and ulnar nerves. Brain 1945;68:243-99.
2. Jabaley ME, Wallace WH, Heckler FR. Internal topography of major nerves of the forearm and hand: a current view. J Hand Surg Am 1980;5:1-18.
3. Plantzer U, Steinke H, Meivensberger J, et al. Median nerve fascicular anatomy as a basis for distal neural prostheses. Ann Anat 2014;196:144-9.
4. Zanette G, et al. Sunderland's Median Nerve Fascicular Anatomy Revisited by Ultrasound. J Neuro Neurosurg Psychiatry 2016;87:3