CASE REPORT

Dorsal Interosseous Muscle Weakness from Mid-palm Ganglion Cyst

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Abstract

Ulnar nerve compression is commonly seen at the elbow at the cubital tunnel and the wrist at the Guyon canal but is rarely seen in the hand. This case report describes an 18-year-old male presenting with seven months of atraumatic hand weakness and atrophy associated with heavy weightlifting. Exam demonstrated isolated interosseous muscle atrophy mostly sparing the abductor digiti minimi with intact sensation and negative nerve compression tests including Tinel at carpal and ulnar tunnels, Froment sign, Wartenberg test, cross finger test, and Spurling test. Electromyography and nerve conduction studies demonstrated prolonged distal latency, low amplitude potential, and large amplitude fibrillations with severely reduced motor unit firing in the first dorsal interosseous muscle consistent with ulnar nerve deep motor branch compromise. Magnetic resonance imaging revealed a ganglion cyst between the third metacarpal shaft and the flexor profundus tendon. Given the progressive symptoms, ganglion cyst excision and ulnar motor nerve branch neurolysis were performed.

Level of evidence: V

Keywords: Ganglion cyst, Interosseous muscle atrophy, Nerve compression, Neuropathy, Ulnar nerve

Introduction

Ulnar nerve compression most commonly occurs at the elbow at the cubital tunnel but also occurs at the wrist within the Guyon canal.[1,2] The Guyon canal is the area at the base of the hypothenar eminence from the palmar carpal ligament to the fibrous arch of the hypothenar muscle at the level of the hook of the hamate. As the ulnar nerve travels within the Guyon canal it bifurcates into the superficial branch and deep motor branch. The superficial branch innervates the palmaris brevis muscle and provides sensation to hypothenar eminence, small finger, and ulnar ring finger. The deep motor branch exits the Guyon canal by coursing around the hook of the hamate and turning radially through the pisohamate hiatus to innervate the hypothenar muscles, the medial two lumbricals, the pollicis, and the interosseous muscles.[1] The location of compression along the ulnar nerve dictates symptoms and three zones of compression at Guyon canal have been described. Zone I is before ulnar bifurcation causing mixed motor and sensory symptoms. Zone II is motor branch compression distal to the bifurcation causing isolated motor symptoms. Zone III is superficial ulnar nerve distal to the bifurcation resulting in isolated sensory loss.[1,3,4] Masses in the hand can also present within and around the Guyon canal as palpable painful masses without causing neurologic symptoms.[5,6] More distal ulnar nerve compression within the hand is exceedingly rare. This case report shows a unique presentation of a large mid-palmar ganglion cyst compressing the distal motor branch of the ulnar nerve in a young, active patient.

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Case Presentation

An 18-year-old right-hand-dominant male presented with seven months of atraumatic right hand pain, weakness, and atrophy associated with heavy weightlifting. Pain and weakness worsened with weightlifting and improved after a period of limited weightlifting. He had no pertinent medical

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history. The patient was a high school student active in playing lacrosse, football, and weightlifting.

A physical exam showed thumb-index intermetacarpal muscle wasting. There were no palpable masses in the wrist or hand. Strength testing demonstrated 3 out of 5 strength to the first dorsal interosseous muscle and 5- out of 5 strength to the abductor digiti minimi. The remaining muscles tested showed 5 out of 5 strength, including the ulnar flexor digitorum profundi. Sensation was intact in the ulnar, radial, and median nerve distributions. Reflexes and pulses were normal. Special tests were all negative, including Tinel at the carpal and ulnar tunnels, Froment sign, Wartenberg test, cross finger test, Spurling test, and Lhermitte sign.

Nerve conduction velocity studies (NCS) revealed a prolonged distal latency to the first dorsal interosseous with a low amplitude potential response which did not increase with midpalmar stimulation. Distal latency to the abductor digiti minimi and sensory distal latency to the fifth finger were both normal. Conduction velocity distal to and across the elbow was normal with the recording electrode over the abductor digiti minimi and first dorsal interosseous. Electromyography (EMG) demonstrated large amplitude fibrillations with severely reduced motor unit firing in the first dorsal interosseous muscle, as well as a very mild decrease in recruitment and polyphasiciity in the abductor digiti minimi [Figure 1, Tables 1-3]. These findings were consistent with the ulnar nerve mid-palm lesion with significant subacute axonopathy affecting the first dorsal interosseous muscle but sparing the ulnar sensory nerve and most of the motor nerve to the abductor digiti minimi. Abductor pollicis brevis, pronator teres, flexor digitorum profundus, biceps and triceps muscles, and median nerve were all normal.

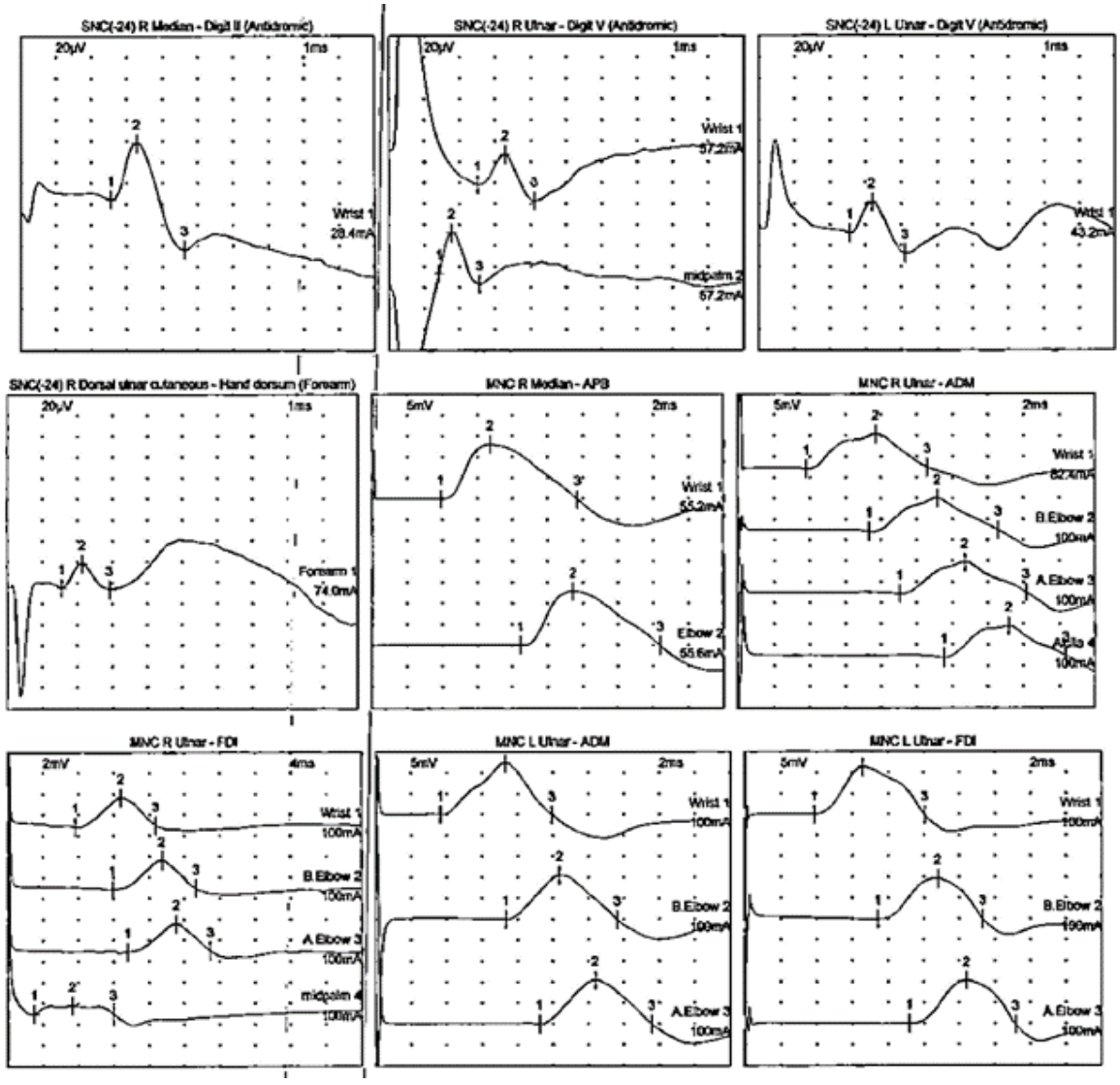

Figure 1. Electromyography (EMG) and nerve conduciton studies (NCS) results demonstrating first dorsal interosseous muscle large amplitude fibrillations with severely reduced motor unit firing and mild decrease in recruitment of the abductor digiti minimi

Table 1.Electromyography

Muscle	Nerve	Roots	Spontaneous				Motor Unit Action Potentials			Recruitment Pattern
			Insertion Activity	Fibrillation	Positive Sharp Waves	Fasciculation	Amplitude	Duration	Polyphasic potentials	
Abductor pollicis brevis	Median	C8-T1	Normal	None	None	None	Normal	Normal	Normal	Normal
First dorsal Interosseous	Ulnar	C8-T1	2+	Large	None	None	Normal	1+	1+	Reduced
Abductor digiti minimi (manus)	Ulnar	C8-T1	Normal	None	None	None	Normal	Normal	Normal	Reduced
Pronator teres	Median	C6-C7	Normal	None	None	None	Normal	Normal	Normal	Normal
Flexor digitorum profundus, 4-5	Ulnar	C8-T1	Normal	None	None	None	Normal	Normal	Normal	Normal
Triceps brachii	Radial	C6-C8	Normal	None	None	None	Normal	Normal	Normal	Normal
Biceps brachii	Musculo-cutaneous	C5-C6	Normal	None	None	None	Normal	Normal	Normal	Normal

Table 2. Sensory Nerve Conduction

Nerve/Site	Onset Latency (ms)	Peak Latency (ms)	Amplitude (μV)	Distance (cm)	Peak Difference (ms)	Velocity (m/s)
Right Median – Digit II (Antidromic) at Wrist	2.55	3.28	101.8	14	-	55
Right Ulnar – Digit V (antidromic) at Wrist	2.50	3.28	44.4	14	-	56
Right Ulnar – Digit V (antidromic) at Midpalm	1.41	1.77	49.6	-	-1.51	-
Left Ulnar – Digit V (antidromic) at Wrist	2.55	3.18	48.9	14	-	55
Right Dorsal Ulnar Cutaneous – Hand dorsum (forearm)	1.56	2.14	24.5	8	-	51

Table 3. Motor Nerve Conduction

Nerve	Muscle	Site	Latency (ms)	Amplitude (mV)	Duration (ms)	Relative Amplitude (%)	Segments	Distance (cm)	Latency Difference (ms)	Velocity (m/s)
Right Median	***Abductor pollicis brevis (APB)***	***Wrist***	3.91	13.0	7.81	100	Wrist-APB	8	---	---
		Elbow	8.44	12.9	7.97	99.3	Elbow-Wrist	24	4.53	53
Right Ulnar	***Abductor Digiti Minimi (ADM)***	***Wrist***	3.80	8.3	8.77	100	Wrist-ADM	8	---	---
		Below Elbow	7.34	7.9	7.24	95.6	Below Elbow – Wrist	20	3.54	56
		Above Elbow	9.06	7.6	7.08	95.9	Above – Below Elbow	10	1.72	58
		Axilla	11.56	7.5	6.82	99	Axilla – Above Elbow	13	2.50	52
	First Dorsal Interosseous (FDI)	***Wrist***	7.66	2.8	9.11	100	Wrist – FDI	8	---	---
		Below Elbow	11.88	2.8	9.43	99	Below Elbow – Wrist	20	4.22	47
		Above Elbow	14.65	2.7	9.32	94.9	Above – Below Elbow	10	1.77	56
		Midpalm	3.02	0.8	8.96	29.7	Midpalm – Above elbow	---	-10.63	---
		---	---	---	---	---	Above Elbow – wrist	---	5.99	---

Table 3. Continued

Left Ulnar	***Abductor Digiti Minimi (ADM)***	***Wrist***	3.65	12.4	6.30	100	Wrist-ADM	8	---	---
		Below Elbow	7.34	10.6	6.30	85.5	Below Elbow – Wrist	20	3.70	54
		Above Elbow	9.27	10.5	6.30	99.3	Above – Below Elbow	10	1.93	52
	First Dorsal Interosseous (FDI)	***Wrist***	3.85	11.3	6.20	100	Wrist – FDI	8	---	---
		Below Elbow	7.45	9.7	5.89	85.8	Below Elbow – Wrist	20	3.59	56
		Above Elbow	9.22	10.3	5.94	106	Above – Below Elbow	10	1.77	56
		---	---	---	---	---	Above Elbow – Wrist	---	5.36	---

Hand magnetic resonance imaging (MRI) MRI demonstrated a T2-hyperintense 1.1cm x 1.2cm x 1.4cm mass between the third metacarpal and flexor digitorum profundus tendon of the third ray consistent with a ganglion cyst [Figure 2]. Increased T2-hyperintense signal was also noted within the third dorsal interosseous muscle, and to a lesser degree in the flexor pollicis brevis muscle, consistent with denervation edema.

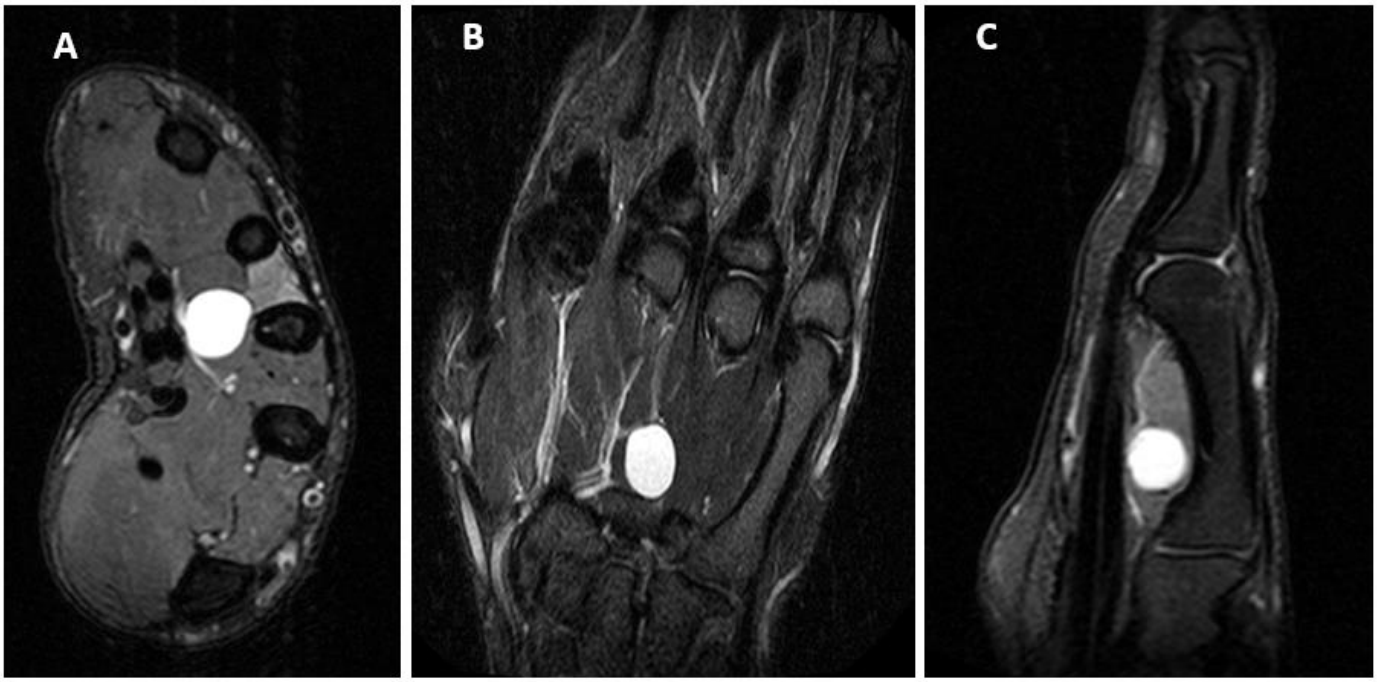

Figure 2. Right hand magnetic resonance imaging (MRI), including (A) axial, (B) coronal, and (C) sagittal T2-weight images, demonstrating T2-hyperintense 1.1cm x 1.2cm x 1.4cm mass between the third metacarpal and flexor digitorum profundus tendon. Also noted, increased T2-hyperintense signal within the third dorsal interosseous muscle, and to a lesser degree, in the flexor pollicis brevis muscle

Given the exam, EMG/NCS, and MRI findings, ganglion cyst excision and ulnar nerve neurolysis were indicated. Under general anesthesia, a volar incision was made over the third metacarpal shaft. The median nerve branches and flexor tendons were identified, protected, and retracted to reveal the underlying ganglion cyst superficial to the third metacarpal shaft compressing the motor branch of the ulnar nerve. The gelatinous cyst and stalk were excised [Figure 3a] to decompress the ulnar motor nerve [Figure 3b] along with the ulnar motor nerve external neurolysis.

In the immediate postoperative period, the patient experienced paresthesias in the ulnar nerve distribution of the volar hand. By 1.5 months postoperatively, all paresthesias had resolved and he reported a subjective improvement in his preoperative weakness and pain. The exam demonstrated full hand range of motion, ability to cross his digits, and sensation intact throughout the ulnar nerve distribution. At that time, he was cleared to return to all activities and was eager to return to a home-strengthening program.

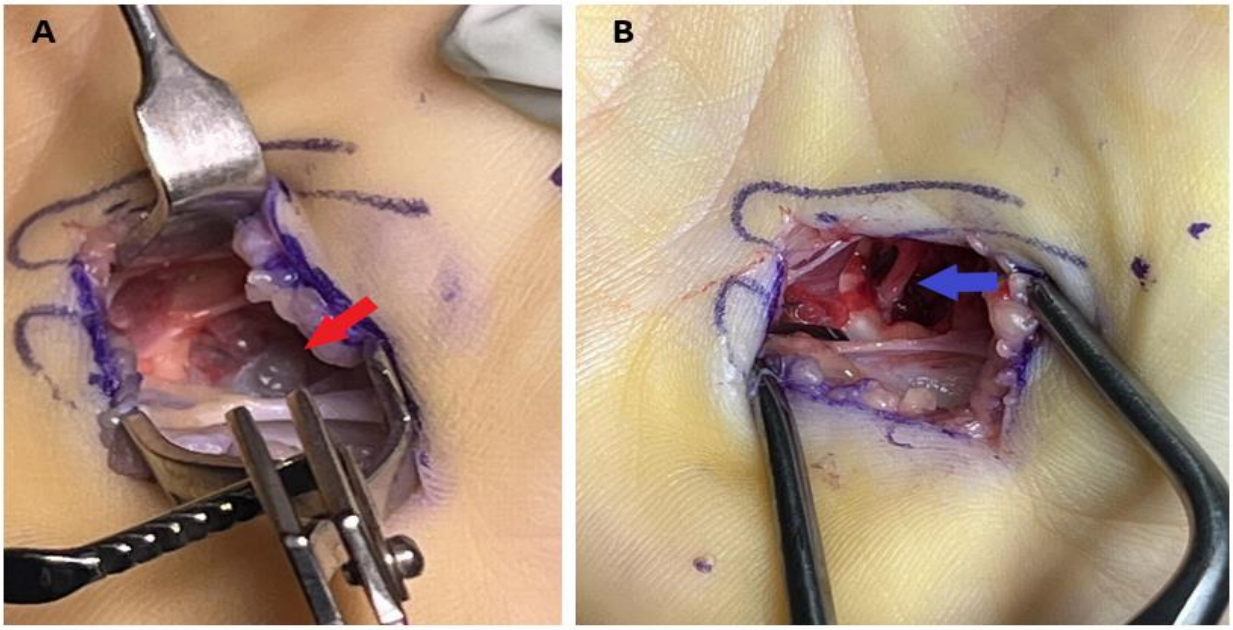

Figure 3. Intraoperative photos demonstrating (A) mid-palmar ganglion cyst (red arrow) compressing the motor branch of the ulnar nerve and (B) decompressed motor branch of the ulnar nerve (blue arrow) following ganglion cyst excision

Discussion

While ulnar nerve compression at the elbow and wrist are well described, this case report demonstrates ulnar nerve compression distal to the Guyon canal within the hand. Ulnar nerve compression at the elbow usually presents with ulnar dysesthesia, pain, and paresthesias in the ulnar nerve distribution, small and ring finger clawing, and ulnar intrinsic muscle weakness.[7] Ulnar nerve compression at the wrist can present as mixed motor and sensory, isolated motor, or isolated sensory symptoms, sparing the dorsal hand, depending on the zone of compression as described by Shea and McClain in 1969.[1,4] Ulnar nerve compression distal to Guyon canal in the hand can also present with hand intrinsic muscle atrophy and weakness, but spares sensation in the ulnar nerve distribution. Furthermore, the specific location of compression along the course of the ulnar nerve dictates which ulnar intrinsic muscles are involved. This was summarized by Wu et al who proposed an expansion of Shea and McClain's zones of ulnar nerve compression in which the pure motor neuropathies caused by isolated compression of the motor branch of the ulnar nerve can be further subdivided into three categories, Wu type III, IV, and V. Type III is compression is after the ulnar nerve bifurcation into motor and sensory branches, but proximal to the motor innervation of the hypothenars. Type IV is distal to innervation to hypothenars and Type V is just proximal to the branches to the first dorsal interosseus and adductor pollicis muscles.[4,8] In this case, the ganglion cyst primarily compressed the ulnar motor nerve distal to the innervation of the abductor digiti minimi, but proximal to the innervation of the first dorsal interosseous muscles which would most closely be described as a Wu Type V lesion.

Ganglion cysts are a well-documented cause of compression within the Guyon canal and have been shown to cause isolated ulnar motor nerve compression within the Guyon canal when arising from the piso-triquetral and triquetral-hamate joints.[1,9,10] In contrast, there are very limited reports of ganglion cysts distal to the Guyon canal in the hand and no prior reports of a ganglion between the third metacarpal shaft and flexor digitorum profundus tendon to the third metacarpal. Two prior case reports have documented nearby ganglia with variance in patient presentation. A case report of a ganglion cyst between the third and fourth metacarpal base showed ulnar motor nerve compression resulting in atrophy and weakness of the adductor pollicis and first dorsal interosseous muscle with a positive Froment sign.[11] Another case report demonstrated a ganglion cyst at the third carpometacarpal joint which resulted in isolated interosseous muscle atrophy, a positive Froment sign, and adductor pollicis weakness on exam.[12] Alternative compressive pathologies in the hand causing isolated ulnar motor branch compression in case reports include pigmented villonodular synovitis,[13] leash of vessels,[14] fibrous bands,[14–16] leash of vessels,[14] and subperiosteal compression.[17]

Conclusion

This case demonstrates a unique presentation of a large mid-palmar ganglion cyst between the third metacarpal shaft and the flexor digitorum profundus tendon to the third ray in a young, active patient. The ganglion resulted in compression of the distal ulnar motor branch, resulting in hand weakness and atrophy. In this patient, prognosis may be guarded based on EMG/NCS testing with a lower amplitude response to the first dorsal interosseous indicative of significant axonal loss to the motor branch of the ulnar nerve. However multiple patient factors may

favor a positive prognosis for recovery via neuronal sprouting and direct regrowth. Namely, the patient is young, the injury is near the affected muscle, and symptoms had only been present for seven months before decompression. Prompt recognition of this rare nerve compressive lesion through thorough physical exam and early comprehensive workup including EMG, NCS, and hand MRI allows for prompt surgical intervention before motor endplate irreversible degeneration to optimize the chance for full motor recovery.

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