Partial Thenar Atrophy as a Physical Manifestation of Martin Gruber Anastomosis

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Abstract

Martin Gruber anastomosis is a frequent finding on electrodiagnostic examination and has three common variants. Much has been written about these variants such as the anatomic course of crossover fibers and the electrodiagnostic findings. However, little has been written on associated physical findings that might suggest such a diagnosis. In this report the physical examination findings clearly supported a diagnosis of a Type III Martin Gruber anastomosis that was initially established through electrodiagnostic testing. Awareness of this pattern on physical examination could provide an early clue to the possible presence of anomalous innervation.

Key words: Martin Gruber Anastomosis, electromyography, median nerve, ulnar nerve.

Resumen

La anastomosis de Martin Gruber es un hallazgo frecuente en el examen electrodiagnóstico y tiene 3 variantes comunes. Mucho se ha escrito acerca de estas variantes tales como el curso anatómico del cruce de fibras y los hallazgos electrodiagnósticos. Sin embargo, es poco lo que se ha escrito sobre los hallazgos físicos con los que se asocia y que podrían sugerir tal diagnóstico. En este reporte, los hallazgos del examen físico apoyaron claramente el diagnóstico de anastomosis de Martin Gruber tipo III el cual fue inicialmente establecido a través del electrodiagnóstico. Tener en cuenta este patrón en el examen físico podría brindar claves tempranas ante la posible presencia de inervaciones anómalas.

Palabras Claves: Anastomosis Martin Gruber, electromiografía, nervio mediano, nervio cubital

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Introducción

Martin-Gruber Anastomosis (MGA) is a frequent finding on electrodiagnostic examination of the upper extremity. Its incidence has been cited as anywhere between 10% to 30% of the general population.[1-4] In most cases[1,5] motor fibers cross over to the ulnar nerve in the forearm either from the main trunk of the median nerve or from one of its branches such as the anterior interosseous nerve. Three primary anatomic variants have been identified: Type I where the first dorsal interosseous muscle is innervated, Type II where the hypothenar eminence is innervated and Type III where muscles in the thenar eminence are innervated.[1] Type II is most common variation (81%) and Type III is the least common(4%).[6]

Most studies have sought to clarify the anatomy of the various forms of MGA or the electrophysiologic findings in order to avoid inaccuracies and confusion in the interpretation of electrophysiologic results. For example Whitaker et al screened patients for a proximal MGA and concluded that patients showing partial conduction block across the elbow for the ulnar nerve must be screened for this anomaly.[7] Meenakshi-Sundaram S et al evaluated patients for the Marinacci communication, an ulnar to median anomaly or the reverse of the MGA.[8]

Case presentation

A 67 year old right hand dominant male complained of occasionally dropping objects and of numbness in his hands bilaterally. The left hand had worse symptoms than the right. He underwent carpal tunnel surgery but symptoms nevertheless continued to worsen. He was unable to fasten buttons if he could not see his hands. Symptoms were worse when he awoke when he then had completely numb hands. Wearing bilateral wrist-hand orthoses for at least a year did not offer any relief. He has been a diabetic for many years.

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Examination	Right	Left
Tinel's at the elbows	-	-
Phalen's test	+	+
Froment's sign	+	+
(note: mildly positive bilaterally)		
OK test:	-	-
Atrophy: Moderate to severe atrophy of the abductor pollicis brevis bilaterally		

Figure 1. Left hand atrophy of the APB (area of skin wrinkling).

Figure 2. Right hand atrophy of the APB (area of skin wrinkling).

Sensation to light touch: diminished on the left.
Electromyographic (EMG) Examination
Key: nl=normal, ms=milliseconds, mV=millivolts, cm=centimeters, um=microvolts, NR=no response, m/s=meters per second, CV=conduction velocity, CMAP=compound muscle action potential, UE=upper extremity, L=left, R=right, FDI=first dorsal interosseus, APB=abductor pollicis brevis, ADM=adductor digiti minimi, FPB=flexor pollicis brevis, PT=pronator teres, UE=upper extremity, PSW=positive sharp waves, fib=fibrillation potentials, IA=insertional activity, PP=polyphasia, Amp=amplitude, Dur=duration, RP=recruitment pattern, IP=interference pattern

Motor nerve conduction studies results:

Nerve/site	Latency (nl)	Amplitude (nl)	CV (nl)
Median R (record at the thenar eminence)			
Wrist(8cm)	5.55ms (<4.5)	0.9 mV (>4.1)	
Elbow	11.5ms	4.2 mV	43.3 m/s (>49)
Note that stimulation at the elbow produced a CMAP with a small initial positive wave.			
Ulnar nerve R (record at the thenar eminence)			
Wrist	4.15	4.6	
Ulnar R (record at the ADM)			
Wrist(8cm)	3.95ms (<3.7)	11.6mV (>7.9)	
Below elbow	9.65ms	8.1 mV	43.5 m/s (>52)
Above elbow	11.85ms	6.7 mV	45.5 m/s (>43)
Median L (record at the thenar eminence)			
Wrist(8cm)	5.25ms (<4.5)	0.6 mV (>4.1)	
Elbow	11.85 ms	2.5 mV	33.3 (>49)
Note that stimulation at the elbow produced a CMAP with a small initial positive wave.			
Ulnar L (record at the ADM)			
Wrist(8cm)	3.65ms(<3.7)	9.7 mV (>7.9)	
Below elbow	7.9ms	9 mV	55.3 (>52)
Above elbow	10.35ms	8.5 mV	42.9 (>43)
Median L (record directly over the atrophic APB)			
Wrist	NR	NR	
Elbow	NR	NR	
Ulnar L (record over the atrophic APB)			
Wrist	NR	NR	
Elbow	NR	NR	
Median L (record over the FPB)			
Wrist	NR	NR	
Elbow	13.2	0.5	
Ulnar L (record over the FPB)			
Wrist	5.4	6.6	
Elbow	12.5	1.8	
Median R (record over the atrophic APB)			
Wrist	NR	NR	
Elbow	10.65	4.2	
Ulnar R (record over the atrophic APB)			
Wrist	4.15	9.3	
Elbow	9.95	4.9	
Median R (record over the FPB)			
Wrist	NR	NR	
Elbow	11.75	1.2	
Ulnar R (record over the FPB)			
Wrist	4.4	8.9	
Elbow	5.25	4.7	

Discussion

This case offers a unique perspective on a common syndrome. As previously mentioned MGA is generally an incidental finding on the electrodiagnostic study and inferred from the results of nerve conduction studies. However, this case suggests that in some instances MGA can be inferred or suspected on the basis of physical findings, and these findings allow the electromyographer to focus on the possibility of MGA early in the study and also to infer which type of MGA is present.

As the photographs illustrate the patient had severe atrophy of his APB on one side and less severe atrophy on the other side. The remainder of the thenar eminence was relatively intact despite the presence of severely compromised motor and sensory axons in the median nerve due to bilateral carpal tunnel syndrome. The putative mechanism of partial thenar preservation would be that the nerve fibers that had crossed over from the median nerve to the ulnar nerve ran unimpeded to the muscles of the thenar eminence so that their muscle bulk and function were preserved.

Sensory nerve conduction studies results:

Nerve/site	Latency (nl)	Amplitude (nl)
Median R (ring electrodes over the middle finger)		
Wrist(14cm)	NR ms (<4)	NR uV (>10)
Mid palm(7cm)	NR ms (<2.4)	NR uV (>10)
Ulnar R (ring electrodes over the fifth finger)		
Wrist(14cm)	4.35 ms (<4)	6.4 uV (>6)
Median L (ring electrodes over the middle finger)		
Wrist(14cm)	NR ms (<4)	NR uV (>10)
Mid palm (7cm)	NR ms (<2.4)	NR uV (>10)
Ulnar L (ring electrodes over the fifth finger)		
Wrist(14cm)	4.2 ms (<4)	11.9uV (>6)

Needle EMG results:

R UE								
Muscle	IA	Fib	PSW	PP	Amp	Dur	RP	IP
FDI	2+	0	0	nl	nl	nl	nl	full
APB	1-	0	0	1+	nl	nl	nl	full
PT	nl	0	0	nl	nl	nl	nl	full

The findings suggest, also, that these fibers did not reach and innervate the APB which would be the muscle most distant to the crossover fibers.

The electrodiagnostic findings support these conclusions. Diagnostic criteria for a MGA were fulfilled bilaterally. These would include a larger CMAP potential at the elbow with a small initial positive wave compared to the one obtained at the wrist for the median nerve. Furthermore testing demonstrated the Type III MGA. The CMAP responses obtained from the thenar eminence with stimulation of the ulnar nerve at the wrist demonstrated that the crossover fibers from the median nerve to the ulnar nerve innervated at least a portion of the thenar eminence.

Review of the literature did not reveal any similar reports of physical exam findings that suggested the MGA. The anatomic studies tended to fall into certain groups. Some assessed which muscles in the hand this anomaly characteristically was responsible for innervating. For example these muscles included the adductor digit minimi, the first dorsal interosseous and the adductor pollicis.[1] Other studies determined where in the proximal to distal distribution the branch from the median to the ulnar nerve occurred.[2,7] Lastly there were studies that determined the nature of the connection. Rodriguez-Niedenführ et al in a cadaver study established a Type I pattern (one branch) and a Type II pattern (two branches).[9] These were further broken down into types a, b, and c. Type a arose from the branch to the superficial forearm flexor muscles. Type b arose the common trunk while type c arose from the anterior interosseus nerve.

Conclusion

The Martin Gruber Anastomosis has been extensively studied both for its anatomic and electromyographic characteristics. This study identifies physical examination aspects that may aid in its diagnosis. Specifically, selective abductor pollicis brevis atrophy in the context of carpal tunnel syndrome complaints may suggest the presence of MGA and particularly the Type III variant.

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