Anomalous Median Nerve Position Dorsal to the Flexor Tendons in a Patient With Spastic Hemiplegia and Wrist Pain: Case Report

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We report an anomalous dorsally positioned median nerve within the carpal tunnel in a 25-year-old spastic hemiplegic man associated with chronic wrist pain. (J Hand Surg 2007; 32A:867–870. Copyright © 2007 by the American Society for Surgery of the Hand.)

Key words: Anomalous median nerve anatomy, spasticity, wrist.

The carpal tunnel is a well-defined channel located in the volar wrist that houses 9 extrinsic flexor tendons and the median nerve, typically lying volar and radial to the tendons. Although variations in median nerve anatomy at the wrist have been described,[1–15] they have mostly dealt with recurrent motor branch anomalies. The purpose of this report is to present the case of a hemiplegic patient with chronic wrist pain whose radiologic and operative findings demonstrated an unusual finding of a completely dorsally positioned median nerve within the carpal tunnel.

Case Report

We present the case of a 25-year-old man with a birth-related left-sided spastic hemiplegia who presented with chronic left-wrist pain. This pain had been worsening over the past year and was localized to the central portion of volar wrist and palm without any radiation to the fingertips. He described the pain as "burning," and it woke him up at night frequently. He denied any associated numbness or paresthesias. Physical exam showed a fixed 30° flexion contracture of the wrist and fixed 45° flexion contractures of the metacarpophalangeal joints. Neck and shoulder range of motion were full with a negative Spurling's test. Strength was 5/5 in all muscle groups of the upper extremity with no thenar wasting. Sensation and 2-point discrimination were normal. He had moderate tenderness to palpation over the proximal palm and central volar wrist, with an increase in pain, but no paresthesias, with Phalen's maneuver[16] and Durkan's forearm compression test in which direct pressure is applied over the volar wrist.[17] Tinel's sign[18] was negative.

After a trial of splinting, hand therapy, and nonsteroidal anti-inflammatory medication failed to provide any relief, an electromyography/nerve conduction velocity study and a wrist magnetic resonance image were obtained. The electromyography/nerve conduction velocity results were negative for any signs of muscle denervation or conduction delay. Magnetic resonance imaging (MRI) of the wrist, not including the forearm, was obtained and showed normal wrist ligaments and cartilage surfaces. It also showed that the median nerve lay in an abnormal position, completely dorsal to the flexor tendons within the carpal tunnel (axial MR images presented in Fig. 1A, B).

Although the patient's history, physical exam, and neurodiagnostic testing were not consistent with the classic presentation of carpal tunnel syndrome (CTS), we offered him a cortisone injection in the carpal tunnel based on the theory that his symptoms were caused by some sort of inflammation within this closed space. Local anesthetic was delivered with the cortisone and produced temporary paresthesias in the radial fingers, thus confirming that the cortisone was

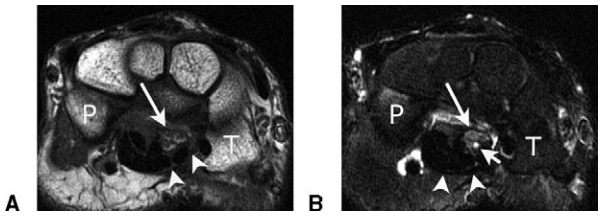

Figure 1. MRI (1.5 T) of the patient's left wrist. (A) Axial T1 (TR/TE: 690/20) and (B) axial proton density fat-saturated (3190/51) images are shown. The radial and ulnar pillars of the carpal tunnel are delineated (T, trapezium; P, pisiform), and the median nerve (long-tailed arrow) is well visualized dorsal to the low-signal flexor tendons (short-tailed arrows) and flexor retinaculum (arrowheads).

indeed delivered within the carpal tunnel. Carpal tunnel pressure measurements were not taken. The cortisone injection provided the patient with "100% relief" of his symptoms for 3 weeks, after which his symptoms returned. At this point, we theorized that his pain was due either to a flexor tenosynovitis from his spastic tendons rubbing against the flexor retinaculum or an atypical compressive median neuropathy possibly due to an abnormal amount of soft tissue bulk volar to his nerve. The former theory was not supported by the normal appearance of the flexor tendons on his wrist MR images (Figs. 1A, B, and 2). Similarly, the latter theory was not supported by the normal enhancement of a perineural vein on his MR images (short-tailed arrow in Fig. 2), which is consistent with a normal intracompartmental pressure within the carpal tunnel.

Based on his dramatic improvement from the cortisone injection, the patient was offered a carpal tunnel release (CTR), although we remained uncertain with respect to his underlying diagnosis. After informed consent was obtained, in which we discussed with him the possibility of postoperative flexor tendon bowstringing due to his spasticity, a CTR was performed using a 2.0-cm incision (mini-open) technique. In an attempt to try to relax his wrist for positioning purposes, this operation was performed under general anesthesia. Intraoperatively, the median nerve was indeed located dorsal to the flexor tendons and appeared normal in appearance. The recurrent motor branch was identified as coming off the median nerve extraligamentously, distal to the transverse carpal ligament (TCL). After fully releasing the TCL, we did not observe the median nerve alter its posititon within the carpal tunnel. Because we did not explore more proximally into the forearm, we are uncertain how the median nerve came to lie dorsal to the flexor tendons within the carpal tunnel. His hand was dressed in a light, soft dressing after the procedure, and digital motion was encouraged immediately postoperatively. The patient has remained without symptoms 6 months after his surgery, with no loss of his preoperative motion nor the development of any clinically apparent bowstringing of his flexor tendons.

Discussion

The anatomy of the median nerve has been well described.[19–21] Originating as the terminal branch of the medial and lateral cords of the brachial plexus, the median nerve lies superficial to the brachialis muscle in the antecubital fossa, although anomalies in this region have been described,[22,23] and between the flexor digitorum superficialis and profundus muscles in the forearm. Prior to entering the carpal tunnel in a position volar to the flexor tendons, the median nerve typically resides ulnar to the flexor carpi radialis and radial to the palmaris longus tendon. Although there have been several papers discussing variations in median nerve anatomy in the palm and wrist, including reports of a bifid nerve divided by an anamolous muscle[1] or tendon[2] or a persistent median artery,[3,4] most have focused on variations in recurrent motor branch anatomy[5–13] or variations in motor[14] or sensory innervation patterns.[15,24,25] None of these papers have described a median nerve that resided completely dorsal to the flexor tendons within the carpal tunnel.

Because we did not obtain MR images of this patient's entire upper limb, nor did we explore him proximal to the carpal tunnel at the time of surgery, we are uncertain exactly where his median nerve

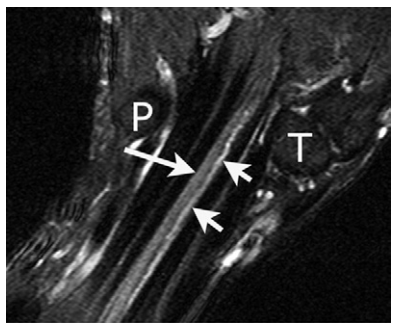

Figure 2. MRI (1.5 T) of the patient's left wrist. Coronal proton density fat-saturated (3190/34) image is shown. The radial and ulnar pillars of the carpal tunnel are delineated (T, trapezium; P, pisiform), and the median nerve (long-tailed arrow) is well visualized. Normal high-signal flow-related enhancement in a perineural vein (short-tailed arrows) suggests that intracompartmental pressure in the carpal tunnel is not excessive.

came to lie in this most unusual position. We theorize that his flexor tendon spasticity, causing pronounced wrist flexion, played a key role in the development of this anomaly. Indeed, Zeiss et al and Skie et al used MRIs of normal volunteers to demonstrate that the relative position of the median nerve within the carpal tunnel changes dynamically based on wrist position.[26,27] As the wrists they studied were placed in a flexed position, the median nerve was found to lie in 1 of 3 positions: (1) volar to the flexor tendons under the flexor retinaculum; (2) interposed between the superficial flexor tendons of the index finger and the flexor pollicis longus; or (3) between the superficial flexor tendons of the middle and ring fingers. Under no circumstances, however, did the median nerve displace entirely dorsal to the flexor tendons.

That the median nerve lay in such an extraordinary position in our patient is likely related to his flexor tendon spasticity. Although CTS is well documented to occur in patients with severe spastic wrist flexion deformities,[28,29] we are uncertain whether this patient's symptoms were secondary to a compressive neuropathy. Orcutt et al[29] noted a 100% correlation between prolonged spastic wrist flexion and the development of CTS in their series of 10 brain-injured patients. Because of the limited cognitive abilities of these patients, the diagnosis was confirmed by electrodiagnostic studies and gross inspection of the nerve at the time of the CTR. Although the mean resting position of the wrists in their series was severe (75° flexion), compared with only 30° in our patient, they did not describe any case in which the median nerve was displaced dorsally by these spastic muscle-tendon units.

It is open to debate why this patient's symptoms initially developed and, subsequently, why they were relieved by our interventions. Even though his symptoms resolved with a CTR, given his lack of numbness and paresthesias in the fingers, it is certainly possible that his pain was not due to a median nerve compression at all. Indeed, there are other causes of wrist pain that could be transiently relieved by a cortisone injection in the carpal tunnel and, more permanently, by a CTR. For example, a stenosing flexor tenosynovitis at the carpal tunnel could conceivably account for the patient's increased pain with Phalen's maneuver. The profound relief he experienced after releasing the TCL may be a result of untethering his spastic flexor tendons therefore, rather than decompressing his median nerve. Although we know that intracarpal pressure[29,30] and median nerve strain[31] increase with wrist flexion, we cannot conclude that this patient's symptoms were due to nerve compression. Furthermore, it is also conceivable that the patient's positive responses to treatment were simply due to a placebo effect. Given the MRI findings of normal-appearing flexor tendons and normal flow-related enhancement in a vein within the carpal tunnel (short-tailed arrows in Fig. 2), the atypical history and exam, and the normal electrodiagnostic studies, it is likely that the intracompartmental pressure within the patient's carpal tunnel was in fact normal. Although negative electrodiagnostic testing does not by itself exclude the diagnosis of CTS,[32] the validity of this diagnosis is called into question within the context of this patient's atypical clinical history and physical exam.

To our knowledge, a dorsal position of the median nerve within the carpal tunnel has never been reported. It is unclear how the median nerve came to reside dorsal to the flexor tendons in this patient, although his flexor spasticity may have played a role. It is also uncertain whether the patient's symptoms were the result of altered carpal bone mechanics, inflammation of the flexor tendons, a compressive neuropathy, or some other reason altogether. Although it is fortunate that this patient did not develop any clinically apparent bowstringing after his CTR, it is important to note that the long-term ramifications of releasing the TCL in spastic patients are not well-known.

Received for publication August 26, 2006; accepted in revised form March 19, 2007.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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0363-5023/07/32A06-0016$32.00/0
doi:10.1016/j.jhsa.2007.03.011

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