



As a new physical therapist, one of the first things I learned was to always clear the spine. This was especially the case for patients with symptoms of peripheral nerve pathology. I was taught to perform tests at the spine such as range of motion, traction, Spurling's test, vertebral spring testing, stability testing, neural dynamic testing, and many more. If spine assessment increased or decreased the patient's peripheral nerve symptoms, it indicated that spinal structures contributed to the symptoms. If a patient presented with bilateral peripheral nerve symptoms, I was even more suspicious that the spine was involved. When the spine exam reproduced symptoms, I would educate the patient that nerve compression at the spine was the primary problem, discuss unsupported concepts like double crush syndrome,¹ downplay the importance of peripheral treatments, and focus my interventions at the spine.

After learning more about the complexity of peripheral nerve pathology, I realized that my initial training overemphasized the influence of proximal nerve pathology on distal structures. I used to assume that the impact was only in one direction (proximal to distal), and I failed to consider that peripheral nerve pathology could have proximal ramifications. What I now understand is that several studies have demonstrated that peripheral nerve injury can result in neuroinflammation at the dorsal root ganglia,² spinal cord,³ and periaqueductal grey areas of the brain.⁴ Neuroinflammation is an activation of glial cells in response to injury or pathology in the nervous system. Glial cell activation results in the release of cytokines and chemokines that drive peripheral and central sensitization.⁵⁻⁷ This inflammatory response can even spread to the dorsal root ganglia and spinal cord on the contralateral side.^{8,9} These findings demonstrate that distal nerve injury can result in proximal sensitization. As a result, in some patients with peripheral nerve pathology, positive exam findings at the spine may be a result of neural sensitivity caused by the distal nerve disorder. In patients with bilateral symptoms, the original peripheral nerve pathology may have contributed to symptoms on the contralateral side.

To better illustrate these concepts, let's consider a 45-year-old electrician with carpal tunnel syndrome. The patient reports that his symptoms started 4 weeks ago in his right hand, and about a week ago, he started getting similar symptoms in his left hand. Upon examination, the patient reported pain in both wrists and tingling in his 1st to 4th fingers bilaterally. Cervical side bending (right and left) increased symptoms ipsilaterally, cervical compression increased symptoms bilaterally, and cervical traction reduced symptoms bilaterally. Based on this presentation, I previously would have concluded that nerve root compression at the cervical spine was a significant influence on the development of this patient's bilateral carpal tunnel syndrome. However, as stated above, it is possible that the original right median nerve entrapment led to neuroinflammation and sensitization at the ipsilateral and contralateral dorsal root ganglion, spinal cord, and brain. This inflammation brought on the contralateral symptoms and sensitized the nerve root, resulting in the positive cervical findings. After undergoing a release of his right carpal tunnel, the symptoms in both hands subsided, and his cervical exam became negative.¹⁰

Clinical Pearls:

- 1) Peripheral nerve pathology can cause neural inflammation and sensitization in the dorsal root ganglion, spinal cord, and brain. ^{2-4,6}
- 2) Peripheral nerve pathology can cause neural inflammation and sensitization on the contralateral side.⁵
- 3) Positive spinal exam findings associated with peripheral nerve disorders may be caused by the peripheral pathology.
- 4) Treatment of the primary peripheral nerve disorder may lead to the resolution of contralateral and central symptoms.⁷

Although peripheral nerve pathology is local in nature, it can influence neural function at distant sites. Physical therapists should be aware of peripheral nerve disorder's proximal and contralateral implications and consider those factors when making management decisions.

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References:

1. Kane PM, Daniels AH, Akelman E. Double Crush Syndrome. *J Am Acad Orthop Surg*. 2015;23(9):558-562. doi:10.5435/JAAOS-D-14-00176
2. Schmid AB, Coppieters MW, Ruitenber MJ, McLachlan EM. Local and remote immune-mediated inflammation after mild peripheral nerve compression in rats. *J Neuropathol Exp Neurol*. 2013;72(7):662-680. doi:10.1097/NEN.0B013E318298DE5B
3. Hu P, Bembrick AL, Keay KA, McLachlan EM. Immune cell involvement in dorsal root ganglia and spinal cord after chronic constriction or transection of the rat sciatic nerve. *Brain Behav Immun*. 2007;21(5):599-616. doi:10.1016/J.BBI.2006.10.013
4. Mor D, Bembrick AL, Austin PJ, et al. Anatomically specific patterns of glial activation in the periaqueductal gray of the sub-population of rats showing pain and disability following chronic constriction injury of the sciatic nerve. *Neuroscience*. 2010;166(4):1167-1184. doi:10.1016/J.NEUROSCIENCE.2010.01.045
5. Matsuda M, Huh Y, Ji RR. Roles of Inflammation, Neurogenic inflammation, and Neuroinflammation in Pain. *J Anesth*. 2019;33(1):131. doi:10.1007/S00540-018-2579-4
6. Ellis A, Bennett DLH. Neuroinflammation and the generation of neuropathic pain. *BJA*. 2013;111:26-37. doi:10.1093/bja/aet128
7. Ji RR, Nackley A, Huh Y, Terrando N, Maixner W. Neuroinflammation and central sensitization in chronic and widespread pain. *Anesthesiology*. 2018;129(2):343. doi:10.1097/ALN.0000000000002130

8. Hatashita S, Sekiguchi M, Kobayashi H, Konno SI, Kikuchi SI. Contralateral neuropathic pain and neuropathology in dorsal root ganglion and spinal cord following hemilateral nerve injury in rats. *Spine (Phila Pa 1976)*. 2008;33(12):1344-1351. doi:10.1097/BRS.0B013E3181733188
9. Schmid AB, Hailey L, Tampin B. Entrapment Neuropathies: Challenging Common Beliefs With Novel Evidence. *J Orthop Sports Phys Ther*. 2018;48(2):58-62. doi:10.2519/JOSPT.2018.0603
10. Lee JK, Yoon BN, Kim DW, et al. Factors affecting contralateral wrist surgery after one carpal tunnel release in bilateral carpal tunnel syndrome. *Hand Surg Rehabil*. 2022;41(6):688-694. doi:10.1016/J.HANSUR.2022.09.003