TOPICS IN NEUROLOGY

Chiropractic Management of a Patient With Radial Nerve Entrapment Symptoms: A Case Study

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ABSTRACT

Objective: This report describes the case of a patient with chronic radial nerve entrapment symptoms managed with chiropractic care. We propose a complementary functional neurologic assessment of muscle function in different positions that could reveal muscle dysfunctions absent with standard test position.

Clinical Features: A 45-year-old man presented to a private chiropractic clinic with a throbbing pain 5 cm above the right lateral elbow epicondyle radiating onto the back of the lower arm and increasing after using a mouse when working on a computer. A Mill test and a Cozen test created pain near the lateral epicondylitis. The use of complementary functional neurologic assessment for radial nerve entrapment showed changes in manual muscle testing after tests were done in different positions to increase the compression on the nerve.

Intervention and Outcome: Chiropractic management was performed, including myofascial therapy, spinal and proximal radioulnar joint adjustments, neural mobilization, and the use of a splint. After 7 days (2 treatments), the patient showed no elbow pain even if he worked on his computer using a mouse. After a 2-year follow-up, no recurrence was reported.

Conclusion: In this case of radial nerve entrapment symptoms, the patient benefited from chiropractic management using standard chiropractic, applied kinesiology, and neural mobilization techniques. The complementary functional neurologic assessment of radial nerve entrapment proposed revealed muscles dysfunctions absent with the standard test position. These changes in manual muscle testing were useful to determine the possible sites of entrapment in order to direct the therapeutic efforts to these locations. (J Chiropr Med 2019;18;327-334)

Key Indexing Terms: *Nerve Compression Syndrome; Radial Nerve; Chiropractic; Neurologic Examination; Diagnostic Techniques and Procedures; Kinesiology, Applied*

INTRODUCTION

Nerve entrapment is a fairly common problem in the upper limb.[1] Nerve entrapment is a condition caused by direct pressure on a nerve, and it should be considered when a patient experiences pain, weakness, or paresthesia in the absence of a known bone, soft tissue, or vascular injury. The onset of symptoms can be acute or insidious.[2] The exact prevalence of radial nerve entrapment is unknown.[3]

The radial nerve is the largest branch of the brachial plexus and is the continuation of the posterior cord, with nerve fibers C5 to C8 and occasionally T1. The sensory supply region of this nerve extends over the posterior middle part of the upper arm and the forearm, the lateral half of the back of the hand, the dorsal side of the thumb, and the finger carpals II and III (lateral half).[4] The radial nerve and its branches provide motor innervation to the triceps brachii, anconeus, supinator, brachioradialis, abductor pollicis longus, and all the extensors of the wrists and hands.

There are multiple possible sites for a radial nerve entrapment along its course: triangular space (TS) of the shoulder, in the radial sulcus of the humerus (RSH), in the lateral bicipital groove,[4] and as the nerve passes beneath the arcade of Frohse and the supinator muscle.[4,5] Medical diagnosis of the entrapment involves an electrodiagnostic assessment, including nerve conduction velocity studies and needle electromyography.[6] Magnetic resonance imaging is useful if the diagnosis is unclear or recovery is not following expected clinical course.[2] Therapeutic options

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Paper submitted February 28, 2019; in revised form April 29, 2019; accepted July 11, 2019.
1556-3707

https://doi.org/10.1016/j.jcm.2019.07.003

include conservative care (eg, rest, modified activities, splinting at the wrist and elbow, anti-inflammatory drug therapy, and corticosteroid injections) and surgery.[6]

Chiropractic management with complementary use of applied kinesiology (AK) manual muscle testing (MMT) seemed useful in neuropathic conditions, such as meralgia paresthetica and Parsonage-Turner syndrome.[7,8] In addition to standard orthopedic and neurologic assessments, chiropractors with an AK approach use MMT to identify what are believed to be immediate neurologic responses to a variety of challenges and treatments.[9] There is some evidence for good validity[10] and reliability[10-13] of AK MMT in the evaluation of the musculoskeletal and nervous systems, but more research respecting the essential attributes of AK as described by Rosner and Cuthbert is needed.[14] The use of MMT as a functional neurologic examination tool[10,15,16] gives the clinician an opportunity to evaluate the function of all the muscles innervated by the radial nerve and the muscle function in different positions. We propose that this evaluation will guide the clinician to the possible sites of entrapment, directing the therapeutic efforts to the root cause of the problem and restoring optimal neurologic function. A literature review was performed on PubMed and CINAHL to locate any previous literature on chiropractic assessment and treatment of radial nerve entrapment symptoms. A few studies were found describing the chiropractic treatment of radial nerve entrapment symptoms,[17-19] but none of them used MMT as a functional neurologic examination tool in the assessment of radial nerve entrapment.

The purpose of this case study is to describe the management of a patient with radial nerve entrapment symptoms adding the MMT used in AK to standard chiropractic care. Furthermore, we propose a complementary functional neurologic assessment of muscle function in different positions that could reveal muscles dysfunctions absent with a standard test position.

Case Study

A 45-year-old Caucasian male patient in a private chiropractic clinic reported pain 5 cm above the right lateral elbow epicondyle radiating onto the back of the lower arm. The pain appeared gradually 25 years ago while working long hours sitting at his computer and using a wired mouse. The patient described his pain as throbbing and associated it with a feeling of weakness in his lower arm. At rest, he rated his pain at 0 on a pain intensity scale of 0 to 10, but he rated it as a 7 after using a mouse when working on a computer for 20 to 30 minutes. The pain stayed at a 4 out of 10 for 2 to 3 hours after work and then 1 out of 10 for 2 to 3 days. The patient was relieved by resting his arm after working. Surprisingly, the pain was not present when he used a touchpad on his keyboard instead of a computer mouse. He previously received chiropractic care for lateral epicondylitis (3 sessions, spine and elbow adjustments with diversified technique) with no beneficial results.

Vital signs (eg, blood pressure, cardiac and pulmonary auscultation) showed no significant clinical evidence. The results of neurologic and vascular examinations were normal. Postural evaluation revealed head rotation and elevation to the right. Range of motion (ROM) measurements were taken by visual analysis. The neck, right elbow, and wrist ROM were normal, and right shoulder abduction was pain-free but limited to 160 degrees. Orthopedic examination of the neck, right shoulder, and wrist was negative. At the right elbow, a Mill test and a Cozen test[20] created pain near the lateral epicondylitis. Palpation revealed pain over the right RSH (4 of 10) and trigger points over right teres major, supinator, and pronator quadratus. Subluxations were found with palpation at the right proximal radioulnar joint (posterior) and at C6 (anterior right).

All the muscles innervated by the radial nerve were tested using MMT in standard position as described by Kendall.[21] The chiropractor had 7 years of experience in AK using MMT as taught by the International College of Applied Kinesiology.[14] Manual assessment of muscular function in AK is a clinical measure of neurologic function; a muscle that meets the demands of manual muscle testing, giving the appearance of strength, is termed *conditionally facilitated*, and a muscle that fails to meet the demands of manual testing, giving the appearance of weakness, is termed *conditionally inhibited*.[15] In this case, MMT showed that all the muscles innervated by the radial nerve were conditionally facilitated[15,16] with the patient sitting and having the forearm in a position between pronation and supination. The proposed functional neurologic assessment of muscle function in different positions was done to increase radial nerve compression on the right. The right abductor pollicis longus (APL), conditionally facilitated in standard position as described by Kendall et al[21] (Fig 1), was then used as an indicator muscle for the radial nerve's function in different positions.

Figures 2 through 5 illustrate the anatomy of the possible locations for radial nerve entrapment and describe the proposed tests to increase the compression on the nerve at these locations. (Note: The figures illustrate the tests on the left side to match the anatomy photographs.)

The right APL was conditionally inhibited after the proposed tests were done to increase the compression on the radial nerve in the TS, the RSH, and the arcade of Frohse/supinator muscle. Considering these results, MMT was done on the muscles surrounding these compression sites (ie, neck, shoulder, elbow, and wrist). MMT showed inhibition of the right sternocleidomastoid (clavicular head), subscapularis, infraspinatus, and pronator teres.

Considering these findings, the working diagnosis was a chronic right radial nerve entrapment syndrome associated with cervical and right elbow joint dysfunction. It was suspected that there was compression of the radial nerve in the TS, the RSH, and the arcade of the Frohse/supinator muscle.

Fig 1. *Manual muscle testing of the right abductor pollicis longus in standard position as described by Kendall et al.[21]*

Management and Outcomes

On the first visit, the aim was to direct the therapeutic efforts to the 3 suspected sites of radial nerve entrapment.

Near the triangular space, origin-insertion (O-I) technique was performed on the right sternocleidomastoid (clavicular head), subscapularis, and infraspinatus. Originally described by Goodheart et al,[22,23] O-I technique consists of deep massage of nodules found at the origin or insertion of the conditionally inhibited muscles, changing its state to conditionally facilitated. The right teres major was treated using a fascial release (FR) technique, consisting of deep massage of the muscle in a stretched position to release myofascial adherences. This therapy is indicated when a conditionally facilitated muscle is stretched and then becomes conditionally inhibited. Therapy is based on the idea that the muscle and fascia are not functioning in harmony and the muscle will be shortened in its resting length, causing a limited ROM of the affected joint.[22,24]

In the RSH, neural mobilization of the radial nerve was performed to release the fixation with the surrounding tissues. A two-point contact technique was used on the nerve, mobilizing it in a distal direction.[4]

Beneath the arcade of Frohse/supinator muscle, the O-I technique was performed on the pronator teres, the supinator was treated using the FR technique, and a strain−counterstrain (SCS) technique was done on the pronator quadratus to relieve trigger points. The SCS technique[25, 26] is indicated when a conditionally facilitated muscle becomes

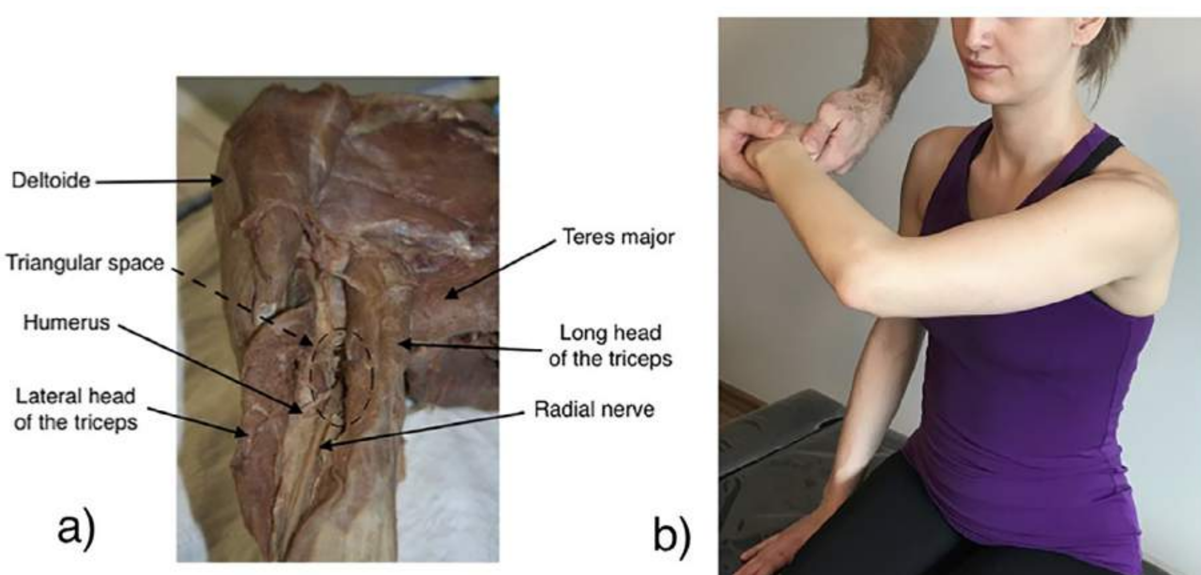

Fig 2. *(A) Posterior view of the left shoulder. The radial nerve can be seen as it passes through the triangular space (TS) of the shoulder. The TS is bordered by the long head of the triceps, the humerus, and the teres major. (B) Manual muscle testing of the abductor pollicis longus for radial nerve entrapment in the TS. Shoulder and elbow flexion 90°, internal rotation of the shoulder 90° (patient forearm in the horizontal plan), and horizontal adduction of the shoulder, in order to stretch the long head of the triceps and to close the TS.*

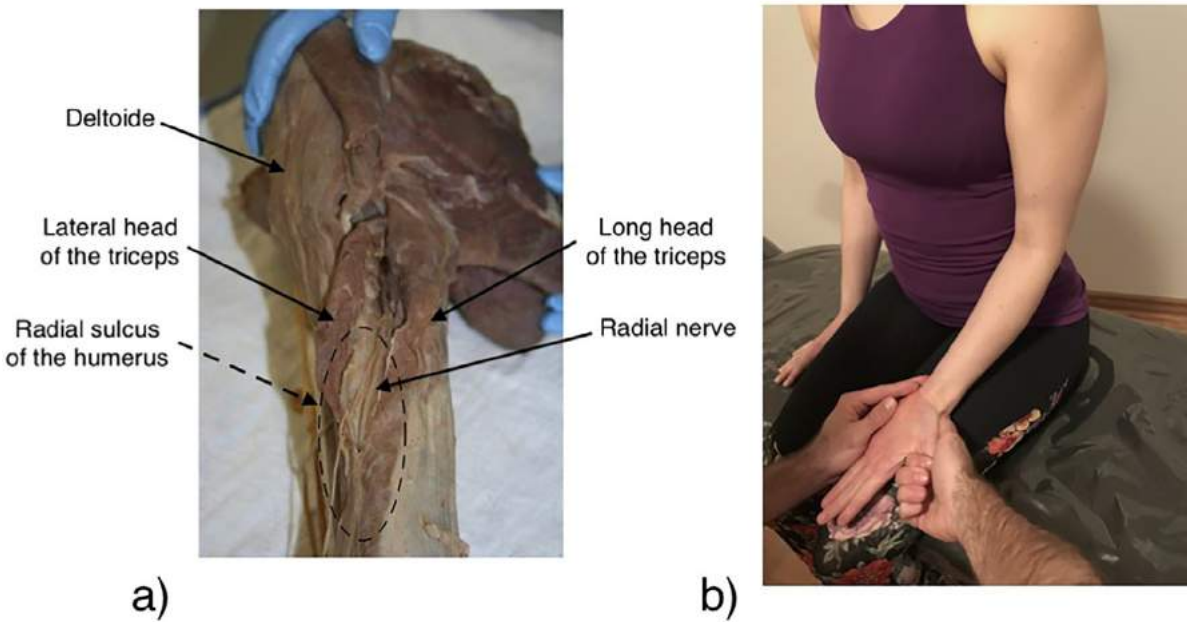

Fig 3. *(A) Posterolateral view of the left shoulder and arm. The radial nerve can be seen in the radial sulcus of the humerus (RSH). (B) Manual muscle testing of the abductor pollicis longus for radial nerve entrapment in the RSH: contraction of the lateral head of the triceps against the patient's thigh (elbow flexed, forearm in supination position and pushing down).*

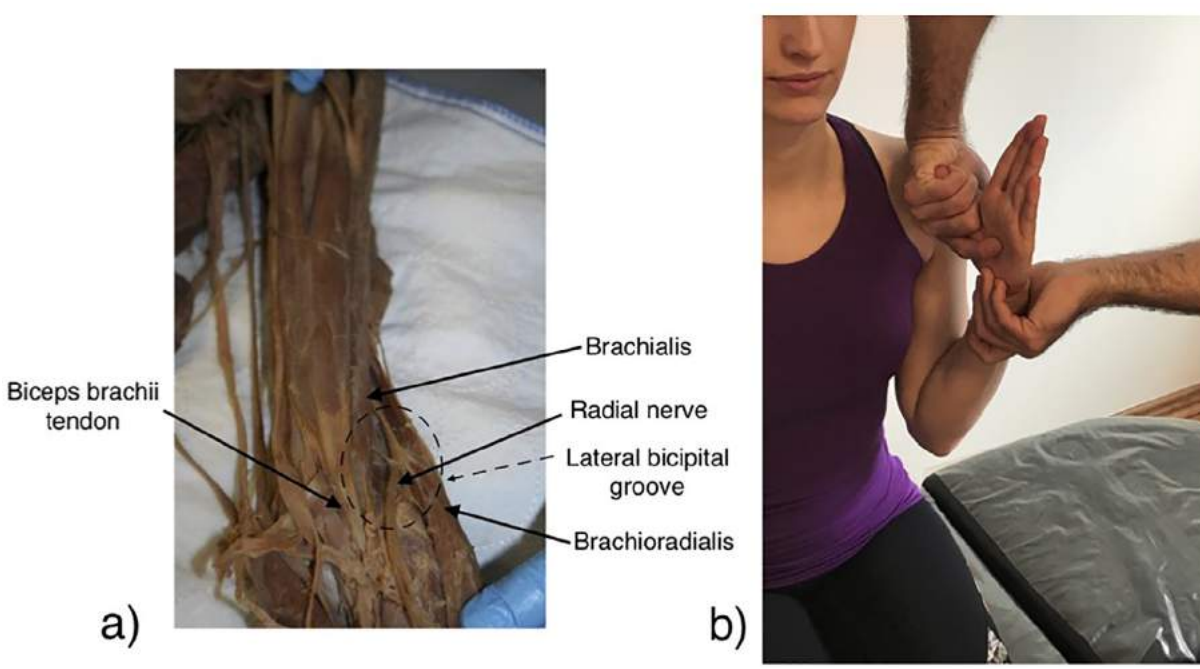

Fig 4. *(A) Anterior view of the left arm, elbow, and forearm. The radial nerve can be seen in the lateral bicipital groove. The lateral bicipital groove is bordered laterally by the brachioradialis, posteriorly by the brachialis, and medially by the biceps brachii tendon. (B) Manual muscle testing of the abductor pollicis longus for radial nerve entrapment in the lateral bicipital groove: full-forced flexion of the elbow with the forearm in a neutral position between pronation and supination, in order to contract the brachioradialis.*

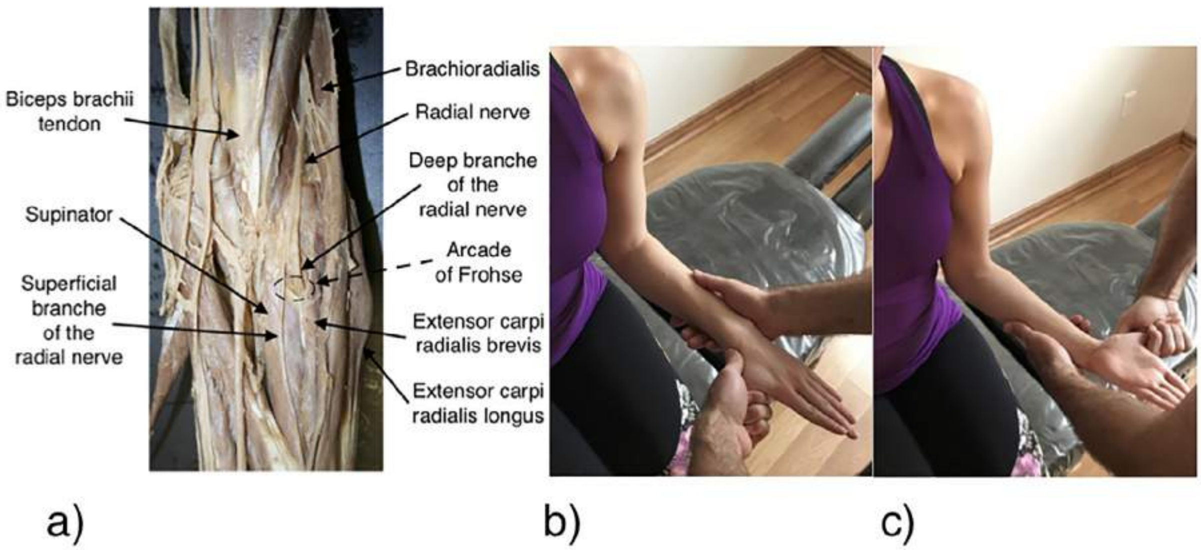

Fig 5. *(A) Anterolateral view of the left arm, elbow, and forearm. The radial nerve is shown crossing the elbow joint line and branching into its superficial and deep branches. The deep branch can be seen as it passes beneath the arcade of Frohse, which the most proximal aspect of the superficial head of the supinator muscle. (B) Manual muscle testing of the abductor pollicis longus for radial nerve entrapment as the nerve passes beneath the arcade of Frohse/supinator muscle (option 1): elbow flexed at 90°, and patient's forearm is in full pronation to stretch the supinator. (C) Manual muscle testing of the abductor pollicis longus for radial nerve entrapment as the nerve passes beneath the arcade of Frohse/supinator muscle (option 2): elbow flexed at 90°, and the patient performs a supination of the forearm to contract the supinator.*

conditionally inhibited after it has maximally contract for 3 seconds.[22] The proximal radioulnar joint was adjusted posterior to anterior and C6 was adjusted anterior to posterior, using diversified chiropractic techniques.

After these corrections, postural assessment was conducted again. Head position was leveled, shoulder ROM was normal, and no muscle weakness was present in the different test positions for radial nerve entrapment. A splint with PowerFlex tape (a fabric-based cohesive flexible tape made by Andover Healthcare, Salisbury, MA) was applied around the forearm of the patient, just inferior to the epicondyles, to stabilize it for 2 weeks.

On the second visit, 7 days later, the patient reported no elbow pain although he worked 3 times on his computer using a mouse. Re-examination indicated negative Mill test and Cozen test results. Palpation revealed no pain over the RSH. No muscle inhibition was present in the different test positions for radial nerve entrapment. O-I technique was done on the pronator teres, and deep massage of the lateral head of the triceps in a stretched position was performed. C6 was adjusted anterior to posterior. The patient continued with elective care at the clinic. No further symptoms of elbow pain returned during the last 2 years after follow-ups. The patient gave consent for his personal health information to be published in this case report.

Discussion

The complementary functional neurologic assessment of radial nerve entrapment revealed muscles dysfunctions absent with standard test position. In this case, the right APL, previously conditionally facilitated in standard position as described by Kendall et al,[21] was conditionally inhibited after the proposed tests were done to increase the compression on the radial nerve in the TS, the RSH, and the arcade of Frohse/supinator muscle. These changes in MMT were useful to determine the possible sites of entrapment to direct the therapeutic efforts to these locations.

Identifying and treating all sites of entrapment for the radial nerve seemed highly relevant based on the concept of double crush syndrome (DCS), which is a distinct compression at 2 or more locations along the course of a peripheral nerve that can coexist and synergistically increase symptom intensity.[27] A complete understanding of the disease process remains elusive, but the most accepted principle for DCS involves a primary nerve disorder that predisposes the nerve to further injury.[28] Some authors suggest that the term *multifocal neuropathy* is a more appropriate term describing the multiple etiologies (eg, compressive lesions, diabetes mellitus, drug-induced neuropathy) that might synergistically contribute to nerve dysfunction and clinical symptoms.[29] When DCS is present, all entrapments might require treatment for optimal results.[30] Lack of improvement after treatment at one site could be the result of persistent pathology at another site along a peripheral nerve.[28] In this case, the patient previously received chiropractic care for lateral epicondylitis (3 sessions, spine and elbow adjustments with diversified technique) with no beneficial results.

Differential diagnosis of radial nerve entrapment should include lateral epicondylitis, and distinguishing the two can be difficult because physical examination maneuvers that aggravate nerve entrapment can also be positive in patients with lateral epicondylitis[31] (eg, the pain provoked by a Mill test and Cozen test in this case). A differentiating factor is the point of maximal tenderness. In nerve entrapment, this point is about 5 cm distal to the lateral epicondyle[32] or in the supinator.[33] In lateral epicondylitis, the point of maximal tenderness is at the origin of the extensor carpi radialis brevis muscle.[2] However, the two conditions can also be present at the same time, and one condition can lead to the other.[2] In this case, palpation of the lateral epicondyle was normal, but pain was felt in the supinator muscle, suggesting nerve entrapment at this site. It is known that in some cases, entrapment of the radial nerve at the elbow could give rise to a dull ache over the lateral aspect of the elbow, eventually radiating down the posterior aspect of the forearm with absence of paresthesia.[33] The entrapment of the radial nerve in the TS and the RSH could explain why the patient had less pain when he used a touch pad on his keyboard instead of a computer mouse. The use of a computer mouse requires different movements of the shoulder and the elbow compared to the use of a touchpad, and it could have increased nerve compression in the TS and RSH.

It has been postulated in AK that examination findings might be different in postural distortion.[22] Inspired by this concept, a complementary functional neurologic assessment of radial nerve entrapment in different positions was conducted to reveal muscles dysfunctions absent with a standard test position as described by Kendall et al.[21] The four proposed sites of entrapment tested in this case study are based on the work of Barral and Croibier[4] and the paper of Konjengbam and Elangbam.[5] The key point here was to suggest tests to increase radial nerve compression in these known sites for entrapment and to direct the therapeutic efforts to these locations if changes in MMT were observed. According to Caruso and Leisman, the testing procedure for muscle strength used by clinicians with more than 5 years of experience in AK seemed to be more reliable compared with clinicians with less experience.[12] In this case, the clinicians had 7 years of experience in AK using MMT, which could make the tests more reliable.

In this case study, the APL was used as indicator muscle for radial nerve's function because its innervation is distal to all compression sites suspected. Supposing that the distal muscles innervated by radial nerve are conditionally inhibited in the standard test position (eg, APL, extensor pollicis brevis, extensor carpi ulnaris), the clinician should test the proximal muscles (eg, supinator, extensor carpi radialis longus, brachioradialis, triceps brachii) until he finds one that is conditionally facilitated, to know where the main entrapment is.

In this patient's case, once the clinician had determined the possible sites of entrapment, O-I technique, FR technique, SCS technique, chiropractic adjustments, and the splint were all useful to restore muscle function in those specific areas. Neural mobilization might have helped to reduce the entrapment of the nerve in the RSH. There is only limited evidence to support the use of neural mobilizations,[34] but it has been shown to reduce elbow pain in computer users.[35]

In the management of radial nerve entrapment symptoms, studies suggest that conservative care including rest, modified activities, splinting at the wrist and elbow, physical therapy, anti-inflammatory drug therapy, and corticosteroid injections should be required for at least 6 weeks to 3 months before any operative interventions are considered.[2,6] In this case, with the complementary functional neurologic assessment of radial nerve entrapment presented and the conservative care applied to the radial nerve's compression sites suspected, the symptoms resolved after 1 week (2 treatments).

Limitations

Limitations of our study include the lack of outcome measurements, such as questionnaires and electrodiagnostic test. Because electrophysiologic studies are essential for the diagnosis of entrapment neuropathies,[36] a definitive diagnosis could not be confirmed. MMT findings were not corroborated by another practitioner and might have been interpreted differently. A combination of myofascial therapy, chiropractic adjustments, neural mobilization, and a splint was used in this case, making it difficult to distinguish which intervention had the best outcome. The improvement could also be coincidental owing to the patient being unaware of ergonomic modifications they might have performed unwittingly. It is possible that the patient improved because of the normal course of the disorder, and the results of this report might not be generalizable to other patients.

Few studies have assessed chiropractic management with complementary use of MMT in neuropathies, such as radial nerve entrapment. The application of MMT in the functional neurologic assessment, including the 4 suggested sites of entrapment and the 5 proposed tests, should be examined in future studies of radial nerve entrapment. Furthermore, the usefulness of a complementary functional neurologic assessment using MMT for nerve entrapment should be examined for other nerves of the upper limb (eg, median and ulnar), but also when nerve compression is suspected in the neck, lower back, or lower limb.

Conclusion

In this case of radial nerve entrapment symptoms, the patient seemed to benefit from chiropractic management using standard chiropractic, AK, and neural mobilization techniques. The complementary functional neurologic assessment of radial nerve entrapment revealed muscle dysfunctions absent with the standard test position. These changes in MMT seemed useful to determine the possible sites of entrapment to direct the therapeutic efforts to these locations.

Acknowledgments

The authors thank the staff of "Laboratoire d'anatomie humaine, Université du Québec à Trois-Rivières" for their help with cadaveric pictures. The authors also thank François Fortin, DC, for having helped the development of the tests proposed in this study in the assessment of radial nerve entrapment using MMT. Finally, the authors thank John Millett, DC, for reading and providing suggestions on the revised version of this manuscript.

Funding Sources and Potential Conflicts of Interest

The authors are associated with the nonprofit entity of the International College of Applied Kinesiology–Canada (ICAK-Canada). Justin Jefferson-Falardeau is the Director of research of ICAK-Canada. Sébastien Houle is the Past Chairman of ICAK-Canada.

Contributorship Information

Concept development (provided idea for the research): J.J.F.
Design (planned the methods to generate the results): J.J.F.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): J.J.F.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): J.J.F.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): J.J.F., S.H.
Literature search (performed the literature search): J.J.F., S.H.
Writing (responsible for writing a substantive part of the manuscript): J.J.F.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): J.J.F., S.H.

Practical Applications

- In this case of radial nerve entrapment symptoms, the complementary functional neurologic assessment of radial nerve entrapment revealed muscles dysfunctions absent with standard test position.
- These changes in MMT were useful to determine the possible sites of entrapment to direct the therapeutic efforts to these locations.

References

1. Thatte MR, Mansukhani KA. Compressive neuropathy in the upper limb. *Ind J Plast Surg*. 2011;44(2):283-297.
2. Neal S, Fields KB. Peripheral nerve entrapment and injury in the upper extremity. *Am Fam Physician*. 2010;81(2):147-155.
3. Dang AC, Rodner CM. Unusual compression neuropathies of the forearm, part I: radial nerve. *J Hand Surg*. 2009;34(10):1906-1914.
4. Barral J-P, Croibier A. *Manual Therapy for the Peripheral Nerves*. Palm Beach Gardens: FL: Barral Productions; 2012.
5. Konjengbam M, Elangbam J. Radial nerve in the radial tunnel: anatomic sites of entrapment neuropathy. *Clin Anat*. 2004;17(1):21-25.
6. Carter GT, Weiss MD. Diagnosis and treatment of work-related proximal median and radial nerve entrapment. *Phys Med Rehabil Clin N Am*. 2015;26(3):539-549.
7. Houle S. Chiropractic management of chronic idiopathic meralgia paresthetica: a case study. *Journal Of Chiropractic Medicine*. 2012;11(1):36-41.
8. Charles E. Chiropractic management of a 30-year-old patient with Parsonage-Turner syndrome. *Journal Of Chiropractic Medicine*. 2011;10(4):301-305.
9. Conable KM, Rosner AL. A narrative review of manual muscle testing and implications for muscle testing research. *J Chiropr Med*. 2011;10(3):157-165.
10. Cuthbert SC, Goodheart Jr. GJ. On the reliability and validity of manual muscle testing: a literature review. *Chiropr Osteopat*. 2007;15:4.
11. Pollard H, Lakay B, Tucker F, Watson B, Bablis P. Interexaminer reliability of the deltoid and psoas muscle test. *J Manipulative Physiol Ther*. 2005;28(1):52-56.
12. Caruso W, Leisman G. A Force/Displacement Analysis of Muscle Testing. *Perceptual and Motor Skills*. 2000;91(2):683-692.
13. Pollard H, Calder D, Farrar L, Ford M, Melamet A, Cuthbert S. Inter examiner reliability of manual muscle testing of lower limb muscles without the ideomotor effect. *Chiropractic Journal of Australia*. 2011;41(1):23-30.
14. Rosner AL, Cuthbert SC. Applied kinesiology: distinctions in its definition and interpretation. *J Bodyw Mov Ther*. 2012;16(4):464-487.
15. Motyka TM, Yanuck SF. Expanding the neurological examination using functional neurologic assessment part I: methodological considerations. *Int J Neurosci*. 1999;97(1-2):61-76.
16. Schmitt Jr. WH, Yanuck SF. Expanding the neurological examination using functional neurologic assessment: part II neurologic basis of applied kinesiology. *Int J Neurosci*. 1999;97(1-2):77-108.
17. Robb A, Sajko S. Conservative management of posterior interosseous neuropathy in an elite baseball pitcher's return to play: a case report and review of the literature. *J Can Chiropr Assoc*. 2009;53(4):300-310.
18. Feinberg E. Nerve entrapment syndromes about the elbow. *Topics Clin Chiropr*. 1999;6(4):20-81.
19. Politylo J, Decina PA, Lopes AA. Superficial radial neuropathy secondary to intravenous infusion at the wrist: a case report. *J Can Chiropr Assoc*. 1993;37(2):92-96.
20. Evans RC. *Orthopedic Physical Assessment*. St Louis: Mosby; 2002.
21. Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. *Muscles: Testing and Function, with Posture and Pain*. 5th ed Baltimore, MD: Williams and Wilkins; 2005.
22. Walther DS. *Applied Kinesiology Synopsis*. 2nd ed Shawnee Mission, KS: International College of Applied Kinesiology-USA; 2000.

23. Gin RH, Green BN. George Goodheart, Jr., D.C., and a history of applied kinesiology. *J Manipulative Physiol Ther*. 1997;20(5):331-337.
24. Cuthbert S. Applied kinesiology and the myofascia. *Int J AK Kinesio Med*. 2002;13:14.
25. Wong CK. Strain counterstrain: current concepts and clinical evidence. *Man Ther*. 2012;17(1):2-8.
26. Meseguer AA, Fernández-de-las-Peñas C, Navarro-Poza JL, Rodríguez-Blanco C, Gandia JJB. Immediate effects of the strain/counterstrain technique in local pain evoked by tender points in the upper trapezius muscle. *Clin Chiropr*. 2006;9 (3):112-118.
27. Upton AR, McComas AJ. The double crush in nerve entrapment syndromes. *Lancet*. 1973;2(7825):359-362.
28. Kane PM, Daniels AH, Akelman E. Double crush syndrome. *J Am Acad of Orthop Surg*. 2015;23(9):558-562.
29. Cohen BH, Gaspar MP, Daniels AH, Akelman E, Kane PM. Multifocal neuropathy: expanding the scope of double crush syndrome. *J Hand Surg*. 2016;41(12):1171-1175.
30. Osterman AL. The double crush syndrome. *Orthop Clin N Am*. 1988;19(1):147-155.
31. Lubahn JD, Cermak MB. Uncommon nerve compression syndromes of the upper extremity. *Journal Am Acad Orthop Surg*. 1998;6(6):378-386.
32. Moradi A, Ebrahimzadeh MH, Jupiter JB. Radial tunnel syndrome, diagnostic and treatment dilemma. *Arch Bone Jt Surg*. 2015;3(3):156-162.
33. Ombregt L. *A System of Orthopaedic Medicine*. Philadelphia: Elsevier Health Sciences; 2013.
34. Ellis RF, Hing WA. Neural mobilization: a systematic review of randomized controlled trials with an analysis of therapeutic efficacy. *J Man Manip Ther*. 2008;16(1):8-22.
35. Arumugam V, Selvam S, MacDermid JC. Radial nerve mobilization reduces lateral elbow pain and provides short-term relief in computer users. *Open Orthop J*. 2014;8:368-371.
36. Preston DC, Shapiro BE. *Electromyography and Neuromuscular Disorders. Clinical-Electrophysiologic Correlations*. 3rd ed Philadelphia: Elsevier; 2013.