

Manipulative Therapy (Feldenkrais, Massage, Chiropractic Manipulation) for Neck Pain

Christopher Plastaras · Seth Schran · Natasha Kim ·
Deborah Darr · Mary Susan Chen

Published online: 12 May 2013
© Springer Science+Business Media New York 2013

Abstract Neck pain is an extremely common symptom with many possible etiologies. A substantial number of patients are turning to complementary and alternative medicine (CAM). Low-quality evidence supports the beneficial effects of CAM. Feldenkrais, massage therapy, and spinal manipulation are discussed in detail. Complications are generally benign and self-limited, although occasional catastrophic consequences have been documented. Despite the favorable opinion many rheumatologists have of some CAM therapy, many patients are not disclosing CAM use to their medical providers. By expressing interest, asking questions, and taking a shared-decision-making approach, providers can encourage disclosure and provide valuable input.

Keywords Neck pain · Cervicalgia · Chiropractic manipulation · Spinal manipulative therapy · Feldenkrais · Massage · Massage therapy · Complementary and alternative medicine

Introduction

Neck pain is very common and potentially difficult to treat. At any time approximately 15 % of adults are experiencing neck pain [1]. In 2006, neck pain accounted for 13.2 million patient visits in the United States, or more than 1 % of all healthcare visits to hospitals and physicians' offices. Four out of five of these visits were by patients between the ages of 18 and 64, with a slight preponderance of females at 58 % [2]. Conventional medicine offers a variety of treatment options, including pharmacotherapy, physical therapy, injections, radio-frequency ablations, and surgical procedures. Most have, at best, modest efficacy or have associated risks. For these and other reasons, patients often turn to complementary and alternative medicine (CAM).

Various studies have sought to describe patients who use CAM to alleviate pain. As a group, they have substantially better self-reported health and education than non-CAM users. Motives for accessing CAM therapy vary. One cross-sectional study showed that approximately 23 % of users were hoping to avoid invasive procedures, 34 % were disappointed by conventional medicine, and approximately 50 % used CAM as a complement to conventional medicine [3].

CAM use for neck pain may be cost-effective. An analysis of the 2002–2008 Medical Expenditure Panel Survey showed that CAM-using patients did not add to overall medical spending on a nationally representative sample with neck and back conditions. In fact, their adjusted annual medical costs were \$424 lower for spine-related conditions and \$796 lower for total health care expenditure compared

This article is part of the Topical Collection on *Complementary and Alternative Medicine*

C. Plastaras (✉)
Department of Physical Medicine and Rehabilitation, Penn Spine
Center, Penn Medicine Rittenhouse, The University
of Pennsylvania, 1800 Lombard Street, 1st Floor,
Philadelphia, PA 19146, USA
e-mail: Christopher.Plastaras@uphs.upenn.edu

S. Schran
Center for Joint and Spine Relief, 218 Newark Ave,
Jersey City, NJ 07302, USA
e-mail: hshs78@gmail.com

N. Kim
Carmel, IN, USA

D. Darr
Rehabilitation Institute of Chicago, Deborah Darr Physical
Therapy Chicago, Chicago, IL, USA

M. S. Chen
Feldenkrais Guild of North America, Midwest Regional
Representative, River Forest, IL, USA

with non-CAM users. These differences were primarily because of lower inpatient expenditure [4•].

In general, rheumatologists practicing in the United States have a favorable opinion of CAM for joint or spine pain. According to the answers given by more than two-thirds of rheumatologists responding to a national cross-sectional survey, bodywork had the highest perceived benefit. Acupuncture was also perceived as beneficial by more than half of survey responders [5].

Despite rheumatologists' increasing awareness and acknowledgement of the possible benefits of CAM, some patients still do not disclose CAM use to their rheumatologist. In an NIH survey of under-served minority patients with rheumatic diseases, 72 % reported CAM use, but fewer than half had discussed CAM with their physicians [6]. In a survey of adolescents with juvenile rheumatoid arthritis, again more than two-thirds of responders had received one or more types of CAM therapy. Use did not vary with gender, race, or geographical location. Again, fewer than half had discussed CAM use with their healthcare providers [7].

Reasons for non-disclosure have included concern about potential negative responses from providers, belief that the provider does not need to know, and the fact that the provider neither expressed interest nor asked [8]. Patients with greater perception of participation in shared decision-making are more likely to disclose CAM use. Improving shared decision-making strategy as a crucial element of physician–patient communications may enable greater awareness of CAM use and optimum treatment planning [6]. This report on Feldenkrais, massage therapy, and chiropractic manipulation is intended to enable rheumatologists and other clinicians to increase their knowledge so they can more effectively express interest, encourage disclosure, and incorporate CAM discussions into shared treatment-planning with their patients.

Feldenkrais

The Feldenkrais method, commonly known as “Feldenkrais”, is a movement–education technique designed to promote physical function and well-being. Physicist, engineer, and judo practitioner Moshe Feldenkrais, the system's founder, injured his knee as a young man and was told an operation was necessary. Deciding not to undergo surgery, he drew upon his scientific background and body-awareness to apply observations of how children learn to walk to rehabilitative strategies for himself and others [9]. The core principle of Feldenkrais is to first improve one's kinesthetic and proprioceptive self-awareness via guided practice sessions, and ultimately to transform unhealthy habits, movements, and postures into movement patterns that offer the individual greater comfort and ease during performance of physical tasks.

The Feldenkrais method includes both group and individual learning strategies. The group method is also called awareness through movement (ATM). Somewhat like children learning to walk, participants are encouraged to move at their own pace and to increase awareness of their own movements. Often while lying or sitting, they are guided through specific sequences of relatively comfortable movements, learning to eliminate extraneous movement or inefficiency while discovering more comfortable and effective alternatives. Individual lessons, also called functional integration, take a similar approach, with the instructor providing more active assistance with the discovery process by gently and precisely moving the student.

Feldenkrais sessions can provide patients with new insights by challenging common perceptions of pain. The idea that the patient's own stiffness or inefficient movements are contributing to or even causing pain, rather than the consequence of pain, is explored. Feldenkrais sessions are then used to discover and analyze these problems, and to correct them by means of conscious effort. One of the biggest rewards, even before the objective of relearning movement patterns is achieved, is that patients begin to feel empowered as agents of their own recovery.

Feldenkrais does not require a lot of equipment or money. A preliminary study followed seven patients with chronic headaches and/or musculoskeletal pains, with limited or no response to conventional treatment, who participated in an eight-week Feldenkrais program consisting mostly of group ATM lessons. Feldenkrais was compared with 12 other “small, multidisciplinary, outpatient” groups via the National Pain Data Bank. Although the study was not blinded, patient-reported data were favorable for Feldenkrais, with 100 % reporting some level of improvement and 80 % satisfaction, compared with 56 % improvement and 34 % satisfaction for a variety of other outpatient treatment groups. Not only did the patients report feeling better after their course of Feldenkrais treatment, but outpatient pharmaceutical and medical costs were reduced by 40 % compared with before treatment [9].

The scientific literature on Feldenkrais is developing, but is still limited, and only a few studies have focused on Feldenkrais' efficacy for neck conditions. A randomized, controlled trial of female industrial workers with neck and shoulder complaints participating in 16 weeks of Feldenkrais found reduced complaints compared with controls and with those assigned to ergonomic intervention as per the occupational health service [10]. For a group of normal subjects participating in an ATM cervical flexion task, ROM with cervical flexion was improved compared with pre-treatment goniometer measurements [11]. For fibromyalgia-based pain, beneficial effects of 15 weeks of Feldenkrais included reduced pain, improved sleep, and reduced fatigue [12]. For elderly patients with a variety of problems leading to

poor balance, including arthritis, cervical stenosis, myelopathy, or myelomalacia, balance and mobility improvements have been observed for Feldenkrais balance class participants in controlled studies [13, 14].

The risks associated with Feldenkrais are minimal even for “high-risk” groups, for example elderly patients with poor balance [13]. Practitioners are encouraged to participate at their own pace, often beginning by lying or sitting and progressing within their capability. Despite the relative paucity of randomized controlled trials demonstrating efficacy for different diagnoses, the favorable risk-to-benefit ratio and long-term cost-effectiveness should give physicians reasons to encourage active participation. The main barriers to participation may be the limited availability of qualified instruction in some areas. One survey found that most practitioners were located in either New York or California. Most did not have a healthcare background (conventional or CAM), although of those that did, physical therapist was the most common qualification [15]. Although it is not the author’s intention to promote any one specific faction or Feldenkrais association, those interested in finding qualified instruction could begin their search by asking their physical therapist or contacting The Feldenkrais Guild of North America [16].

Massage Therapy

Bodywork, or massage therapy, was believed to be one of the most beneficial types of CAM therapy by rheumatologists who responded to a national survey [5]. It is also one of the oldest documented healing arts, mentioned in numerous ancient texts including the Chinese *Nei Ching* and the Indian *Ayur Veda*, dated between 1000 and 3000 BC by several scholars. Hippocrates’ recommendations for health and well-being also included massage [17]. Massage therapy techniques are too numerous to describe in full: they include “effleurage” or gliding techniques, “petrissage” or kneading techniques, “tapotement” or tapping, and friction techniques [18].

The effects of massage therapy are both local and systemic. Locally, massage therapy can assist with the breakdown of tissue adhesions [19] and increase blood flow and oxygenation of the muscles [20]. At the cellular level, massage has been shown to attenuate production of inflammatory cytokines TNF-alpha and IL-6 and increase mitochondrial biogenesis in exercise-induced muscle damage [21]. Systemic effects include increased blood levels of oxytocin and reduced levels of the stress hormone ACTH [22]. Central nervous system effects include reduced depression, anxiety, and pain, via increases in serotonin and endorphins [19]. In the cervical region, therapeutic massage has been shown to reduce Hoffman’s reflex, or alpha-motor neuron excitability of the

flexor carpi radialis muscle [23], and to improve cervical range of motion [23, 24].

More research is needed to evaluate possible long-term effects of massage for pain reduction, although short-term effects have been documented. The Ottawa Panel concluded in 2012 that massage intervention achieves effective relief of neck-pain symptoms post-treatment, although data for long-term effects are insufficient [25]. Another review article found modest evidence that massage therapy has short-term benefits for relief of fibromyalgia symptoms [26]. Massage therapy may also relieve neuropathic pain after spinal cord injury, although the effect did not persist at two-month follow-up [27].

A 2012 Cochrane review of massage for mechanical neck disorders was unable to offer specific recommendations because of a lack of quality evidence. According to the reviewers, massage therapy led to no substantial reduction in pain intensity. Strain and/or counter-strain techniques may reduce pain tenderness and Chinese massage may improve function. Comparison of massage techniques with each other, with physiotherapy, and with acupuncture found no substantial differences. Conclusions were based on very-low or low-quality evidence, and therefore further research could change these conclusions [28].

Methodology problems inherent in massage therapy research have included small sample sizes, inability to combine data from different massage techniques, lack of documentation of the therapist’s credentials, and lack of blinding [28]. The optimum duration and frequency of massage intervention must also be determined. Moyer and colleagues found in their meta-analysis that substantial pain reduction was measurable after multiple massages, but not after a single massage [29]. Also, few trials have investigated holistic outcomes, for example quality of life or physical function. Patient-related factors should also be addressed. For example, deep tissue massage may be necessary to release trigger points or spasms, although some patients may not tolerate the temporary discomfort that can be associated with such techniques. Perhaps by instructing their therapist to use gentler techniques, shorter rather than longer-term results are achieved.

Massage therapy is usually safe, and complications are mostly benign and temporary. Post-treatment pain is one of the more commonly reported side effects, as is low blood pressure [28]. Serious consequences are rare, although one case study describes a 43-year-old gentleman who suffered from tetraplegia after a neck massage. Imaging studies showed ossification of the posterior longitudinal ligament and a large C5-6 disc herniation with compressive myelopathy. Posterior longitudinal ligament ossification is a known risk factor for myelopathy in the setting of minor trauma, and caution should be exercised when considering mechanical therapy for neck pain [30]. Other contraindications to massage

may also include cancer, unstable fractures, or contagious skin conditions [31].

In the absence of consensus guidelines, individual recommendations should be made on the basis of risk-benefit assessments within the patient–physician shared-decision-making model. The Cochrane reviewers were unable to formulate specific recommendations by means of combining a variety of diagnoses. For example, “mechanical neck disorders” included whiplash-associated pain, myofascial pain, cervical radiculopathy, cervicogenic headache, degenerative changes, and neck pain of “unidentified etiology”. In practice, identifying the primary etiology of neck pain is crucial. Massage would not be the treatment of choice for a cervical radiculopathy with progressive weakness, just as surgery would not be indicated for muscle fatigue resulting from exercise. In the authors’ opinion, it also seems logical that massage therapy may not have long-term benefit for pathology that is proximal to the myofascial level, for example cervical radiculopathy, stenosis, or zygapophysial joint arthropathy. If the primary cause of pain is not determined, referral to a “spine specialist,” for example a rheumatologist, physiatrist, orthopedist, pain or sports medicine specialist, neurologist, or neurosurgeon in a spine practice should be considered. When the decision to use massage therapy has been made, locating qualified providers in The United States is relatively easy, because most states have established education and licensure requirements for massage therapy professionals [32].

Chiropractic Manipulation

Use of provider-based CAM therapy, including chiropractic manipulation, has been increasing [33]. The 2008 prevalence of chiropractic manipulation was estimated at 5 % [34]. Chiropractic care includes, but is not identical to, spinal manipulative therapy (SMT). It also includes rehabilitative exercises, ice, heat, electric stimulation, ultrasound, and lifestyle modifications, among others. For the purposes of this review, the use of SMT for neck pain will be discussed.

Various types of SMT have been described, including unloaded spinal motion, manual repetitive oscillations, and high-velocity low-amplitude (HVLA) manipulation. SMT seeks to restore proper joint mechanics to reduce pain and stress on surrounding tissues. Unloaded spinal motion involves continuous passive motion delivered by motorized tables and application of flexion–distraction techniques. HVLA involves delivering a quick thrust within a joint’s range of motion. When deciding which SMT procedures to use, the individual practitioner may consider factors including the patient’s age, diagnosis, or body habitus [35].

Effects of SMT have been documented. EMG of the deltoid muscle (supplied by C5 and C6 nerve roots) revealed small increases in amplitude and fatigue resistance after C5/C6-targeted manipulations [36]. In an NIH study, 12 weeks of SMT substantially reduced participant-reported pain compared with medication, at follow-up intervals of between eight and 52 weeks. Comparing SMT with a home exercise program, including advice, found no substantial differences. One caveat to this study’s conclusions is that participants and providers could not be blinded [37].

Neck pain can be localized or related to faulty thoracic spine biomechanics, for example reduced thoracic spine mobility [38]. For those who are uncomfortable with neck manipulation, thoracic spine manipulation may provide short-term improvement for patients with mechanical neck pain [39]. A 2010 Cochrane review concluded that evidence that either cervical manipulation or thoracic manipulation can reduce neck pain is of low quality [40].

Similarly to Feldenkrais and massage, adverse effects of SMT are usually mild and self-limited. The most common are local discomfort, headache, tiredness, or radiating discomfort, which usually resolve within 24 h [41]. Rarely, more severe complications can occur, including vertebrobasilar artery (VBA) stroke. The actual incidence of stroke is unknown; estimates have ranged from one in 200,000 manipulations [42] to one in 5.85 million [43, 44]. The frequency of VBA stroke associated with chiropractor visits, however, may not be different from that associated with primary care doctor visits [45]. These rare events are considerably less frequent than those for some non-CAM therapy commonly recommended for musculoskeletal conditions, for example non-steroidal anti-inflammatory drugs (NSAIDs). Clinically-significant upper gastrointestinal episodes occur for 1–2 % of patients who take NSAIDs; estimates of annual NSAID-related deaths in the United States range from 3,200 to 16,500 [46].

Conclusions

Use of provider-based CAM therapy has increased. Low-quality or limited evidence has revealed beneficial effects of Feldenkrais, massage therapy, and chiropractic manipulation for neck pain. Further quality research examining specific CAM intervention for specific diagnostic etiologies of neck pain may lead to clarification of future guidelines. Adverse effects of Feldenkrais, massage, and chiropractic manipulation are generally mild and self-limited, although rare catastrophic events have occurred with massage and chiropractic manipulation. Despite the favorable opinion rheumatologists may have of CAM, many patients are not discussing CAM use with their physician. By demonstrating interest, asking questions, and incorporating CAM into a shared-decision-making

model, physicians may improve disclosure and have the opportunity to provide valuable input.

Conflict of Interest Christopher Plastaras has served as a consultant for TLG Associates; has provided expert testimony as a National Council on Strength and Fitness Job Analysis Task Force Subject Matter Expert; has received grant support from the International Spine Intervention Society; has received speaker honoraria from Elite Rehabilitation Solutions; has received speaker and/or instructor and/or planning committee honoraria to cover meals, travel, and lodging expenses from the Pennsylvania Neurological Society; and holds ownership of the copyright of RICPLAS computer software

Seth Schran declares that he has no conflict of interest.

Natasha Kim declares that she has no conflict of interest.

Deborah Darr declares that she has no conflict of interest.

Mary Susan Chen declares that she has no conflict of interest.

References

Papers of particular interest, published recently, have been highlighted as:

- Of importance

1. Hellmann DB, Stone JH. Arthritis and Musculoskeletal Disorders. In: Tierney Jr LM, editor. *Current Medical Diagnosis and Treatment*. New York: McGraw-Hill; 2007. p. 826–86.
2. United States Bone and Joint Initiative. Spine: Low Back and Neck Pain. In *The Burden of Musculoskeletal Diseases in the United States*. Rosemont, IL: American Academy of Orthopaedic Surgeons. 2011;21–56.
3. Peleg R, Liberman O, Press Y, Shvarzman P. Patients visiting the complementary medicine clinic for pain: a cross sectional study. *BMC Complement Altern Med*. 2011;11:36.
4. • Martin BI, Gerkovich MM, Deyo RA, et al. The Association of Complementary and Alternative Medicine Use and Health Care Expenditures for Back and Neck Problems. *Med Care*. 2012;50:1029–36. *CAM users had significantly better self-reported health, education, and comorbidity than non-CAM users. Adjusted annual medical costs among CAM users was \$424 lower (95 % confidence interval: \$240, \$609; P<0.001) for spine-related costs, and \$796 lower (95 % confidence interval: \$121, \$1470; P = 0.021) for total health care cost than among non-CAM users. Using CAM had low health care utilization and better ratings of health and comorbidity.*
5. Manek NJ, Crowson CS, Ottenberg AL, et al. What rheumatologists in the United States think of complementary and alternative medicine: results of a national survey. *BMC Complement Altern Med*. 2010;10:5.
6. Wallen GR, Brooks AT. To Tell or Not to Tell: Shared Decision Making, CAM Use and Disclosure Among Underserved Patients with Rheumatic Diseases. *Integr Med Insights*. 2012;7:15–22.
7. Seburg E, Horvath K, Garwick A, et al. Complementary and alternative medicine use among youth with juvenile arthritis: are youth using CAM, but not talking about it? *J Adolesc Health*. 2012;51:200–2.
8. Robinson A, McGrail MR. Disclosure of CAM use to medical practitioners: a review of qualitative and quantitative studies. *Complement Ther Med*. 2004;12:90–8.
9. Bearman D, Shafarman S. The Feldenkrais Method in the treatment of chronic pain: A study of efficacy and cost-effectiveness. *Am J Pain Manag*. 1999;9:22–7.
10. Ohman A, Astroem L, Malmgren-Olsson EB. Feldenkrais therapy as group treatment for chronic pain—a qualitative evaluation. *J Bodyw Mov Ther*. 2011;15:153–61.
11. Ruth S, Kegerreis S. Facilitating cervical flexion using the Feldenkrais Method: Awareness through movement. *J Sports Phys Ther*. 1992;16:25–9.
12. Kendall SA, Ekselius L, Gerdle B, et al. Feldenkrais intervention in fibromyalgia patients: a pilot study. *J Musculoskelet Pain*. 2001;9:25–35.
13. Connors KA, Galea MP, Said CM. Feldenkrais Method Balance Classes Improve Balance in Older Adults: A Controlled Trial. *Evid Based Complement Alternat Med*. 2011;2011:1–9.
14. Ullmann G, Williams HG, Hussey J, et al. Effects of Feldenkrais exercises on balance, mobility, balance confidence, and gait performance in community-dwelling adults age 65 and older. *J Altern Complement Med*. 2010;16:97–105.
15. Buchanan PA. A preliminary survey of the practice patterns of United States Guild Certified Feldenkrais Practitioners. *BMC Complement Altern Med*. 2010;10:10–2.
16. The Feldenkrais Method of Somatic Education. Available at <http://www.feldenkrais.com>. Accessed December 2012.
17. Braun MB, Simonson SJ, Howard DC, Sinclair M. Welcome to the world of massage therapy. In: Goucher J, Payne DR, Williams PC, editors. *Introduction to Massage Therapy*. Baltimore: Lippincott Williams and Wilkins; 2008. p. 1–30.
18. Braun MB, Simonson SJ, Howard DC, Sinclair M. Massage strokes and flow. In: Goucher J, Payne DR, Williams PC, editors. *Introduction to Massage Therapy*. Baltimore: Lippincott Williams and Wilkins; 2008. p. 393–430.
19. Moyer CA, Rounds J, Hannum JW. A meta-analysis of massage therapy research. *Psychol Bull*. 2004;130:3–18.
20. Sagar SM, Dryden T, Wong RK. Massage therapy for cancer patients: a reciprocal relationship between body and mind. *Curr Oncol*. 2007;14:45–56.
21. Crane JD, Ogborn DI, Cupido C, et al. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. *Sci Transl Med*. 2012;4:119.
22. Morhen V, Beavin LE, Zak PJ. Massage increases oxytocin and reduces adrenocorticotropin hormone in humans. *Altern Ther Health Med*. 2012;18:11018.
23. Sefton JM, Yazar C, Carpenter DM, Berry JW. Physiologic and clinical changes after therapeutic massage of the neck and shoulders. *Man Ther*. 2011;16:487–94.
24. Topolska M, Chrzan S, Sapula R, et al. Evaluation of the effectiveness of therapeutic massage in patients with neck pain. *Orthop Traumatol Rehabil*. 2012;14:115–24.
25. Brosseau L, Wells GA, Tugwell P, et al. Ottawa Panel evidence-based clinical practice guidelines on therapeutic massage for neck pain. *J Bodyw Mov Ther*. 2012;16:300–25.
26. Kalichman L. Massage therapy for fibromyalgia symptoms. *Rheumatol Int*. 2010;9:1151–7.
27. Norrbrink C, Lundeberg T. Acupuncture and massage therapy for neuropathic pain following spinal cord injury: an exploratory study. *Acupunct Med*. 2011;29:108–15.
28. Patel KC, Gross A, Graham N, et al. Massage for mechanical neck disorders. *Cochrane Database Syst Rev*. 2012;9:CD004871.
29. Moyer CA, Rounds J, Hannum JW. A meta-analysis of massage therapy research. *Psychol Bull*. 2004;30:3–18.
30. Cheong HS, Hong BY, Ko YA, et al. Spinal cord injury incurred by neck massage. *Ann Rehabil Med*. 2012;36:708–12.
31. Plastaras CT, Schran S, Kim N, Sorosky S, Darr D, Chen MS, et al. Complementary and alternative treatment for neck pain: chiropractic,

- acupuncture, TENS, massage, yoga, Tai Chi, and Feldenkrais. *Phys Med Rehabil Clin N Am*. 2011;22:521–37.
32. State boards and requirements. Available at <http://www.massagetherapy.com/careers/stateboards.php>. Accessed December 22, 2012.
 33. Su D, Li L. Trends in the use of complementary and alternative medicine in the United States: 2002–2007. *J Health Care Poor Underserved*. 2011;22:296–310.
 34. Zodet MW, Stevans JM. The 2008 Prevalence of Chiropractic Use in the US Adult Population. *J Manip Physiol Ther*. 2012;35:580–8.
 35. Triano JJ. Biomechanics of spinal manipulative therapy. *Spine*. 2001;1:121–30.
 36. Camargo VMD, Albuquerque-Sendin F, Berzin F, et al. Immediate effects on electromyographic activity and pressure pain thresholds after a cervical manipulation in mechanical neck pain: a randomized controlled trial. *J Manip Physiol Ther*. 2011;34:211–20.
 37. Bronfort G, Evans R, Anderson AV, et al. Spinal manipulation, medication, or home exercise with advice for acute and subacute neck pain: a randomized trial. *Ann Intern Med*. 2012;156:1–10.
 38. Norlander S, Nordgren B. Clinical symptoms related to pain and mobility in the cervicothoracic spine. *Scand J Rehabil Med*. 1998;30:243–51.
 39. Cross KM, Kuenze C, Grindstaff TL, Hertel J. Thoracic spine thrust manipulation improves pain, range of motion, and self-reported function in patients with mechanical neck pain: a systematic review. *J Orthop Sports Phys Ther*. 2011;41:633–42.
 40. Gross A, Miller J, D'Sylva J, et al. Manipulation or mobilisation for neck pain: a Cochrane Review. *Man Ther*. 2010;15:315–33.
 41. Senstad O, Leboeuf C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. *Spine*. 1997;22:435–40.
 42. Michaeli A. Reported occurrence and nature of complications following manipulative physiotherapy in south Africa. *Aust J Physiother*. 1993;39:309–15.
 43. Haldeman S, Kolbeck FJ, McGregor M. Stroke, cerebral artery dissection, and cervical spine manipulation therapy. *J Neurol*. 2002;249:1098–104.
 44. Haldeman S, Carey P, Townsend M, Papadopoulos C. Arterial dissection following cervical manipulation: the chiropractic experience. *CMAJ*. 2001;165:905–6.
 45. Cassidy JD, Boyle E, Cote P. Risk of vertebrobasilar stroke and chiropractic care: results of a population-based case-control and case-crossover study. *Spine*. 2008;33:176–83.
 46. Cryer B. NSAID-Associated Deaths: The Rise and Fall of NSAID-Associated GI Mortality. *Am J Gastroenterol*. 2005;100:1694–5.